Ambidextrous Marketing Organizations

to support

Product Innovation

A Case Study in the Chemical industry

Armand Smits

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Natuurwetenschappen, Wiskunde en Informatica

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The MICORD research program

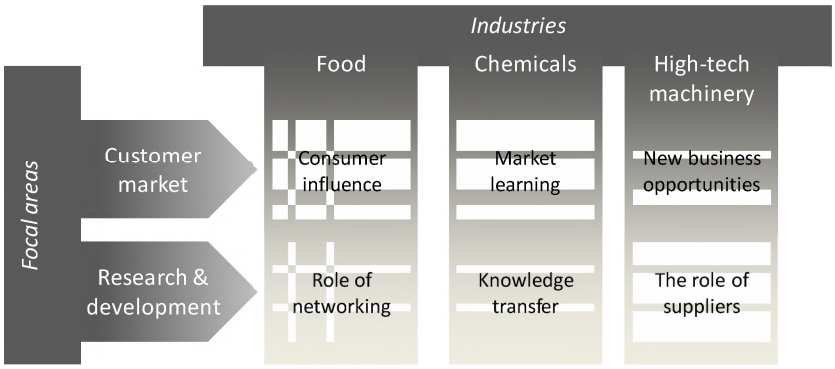
This dissertation is the result of one of the projects within the MICORD program, initiated by Prof. dr. Jan de Wit and Prof. dr. Ben Dankbaar. The MICORD program (acronym for Managing Innovation, Cooperation and Outsourcing of Research and Development) is intended to contribute to the understanding and solution of the so-called 'Knowledge Paradox': universities develop a wealth of new knowledge, but the industry does not seem to be able to use this knowledge for its economic activities. Pre-research carried out in 2004 in 22 companies in different industrial sectors resulted in two probable causes for this:

- Firms have diminished their investments in fundamental research and are therefore not capable anymore of radical innovation
- Industrial researchers are too much oriented on the short term and have lost the ability to effectively communicate with university scientists

Based on these preliminary results we chose to investigate three sectors in more detail: the food industry, the chemical industry and the high-tech machine manufacturing industry. These three sectors are representative for three of the four types of sectors identified by Pavitt (1984) in his influential paper on sectoral patterns of innovation. Moreover, these three sectors are important sectors in the Netherlands, represented by many multinational companies. Within the MICORD program, four PhD projects in the food and chemical industries are based on the two abovementioned causes. In the third sector we found that innovation is already at the center of interest, but we identified two other problems (see figure below):

- What should the role of suppliers be in new product development?
- How can companies develop new business opportunities?

The two projects in the high-tech machinery sector are based on these two problems.



The first four projects started early in 2006 and the other two in the latter half of 2007. The MICORD program is sponsored by the Top Institute Food & Nutrition; TNO Innovation Policy; the Ministry of Economic Affairs; the Ministry of Education, Culture and Science; Dutch Polymer Institute, Akzo Nobel, The Netherlands Organization for Scientific Research (NWO), Philips, ASML and Shell.

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Although being far from an early adopter of new products myself, I gradually became involved in studying product innovation. This expedition started more than a decade ago when I enrolled at Avans University of Applied Sciences and began studying marketing management. At Radboud University, where I continued my studies to obtain a master's degree, I got in contact with the world of innovation and organizational design. This latter environment also aroused my interest in academia. After two years of market research in a business setting I returned to my alma mater to carry out the research that resulted in this book. I hope this book combines the theoretical with the practical, so that both scholars and practitioners will find it to be of value.

As with successful product innovation projects the focal actor in a research project cannot finish the job without the help, support, and perspectives of a great many others. For those people, who have stood by me during this period, I owe many thanks!

First and foremost I would like to express my gratitude to my supervisors, Jan de Wit, Ben Dankbaar, and Geert Vissers. Jan and Ben, this project would never have been born without your efforts concerning developing the financial backing and intellectual roots of the MICORD research program. Jan, your trust, enthusiasm, leadership, and industry network were indispensable. You really stimulated me and gave me the freedom to develop my own ideas. Ben, you strengthened my awareness for the importance of framing my research, formulation, and presentation to maximize impact. Thank you very much for allowing me the opportunities to enter the world of academia both as a researcher and a teacher. And Geert, you always could find the time to patiently guide me during this journey at times when it was necessary. You truly contributed to my work by carefully reviewing my writings and suggesting additional literature and reformulations, even if it took (e-mail) discussions until the last hour before a deadline.

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1 Introduction

This book presents the results of a study on how firms develop ambidextrous marketing organizations to resolve the market learning paradox when developing really new products. This first chapter explicates the reasons for carrying out the research, its objectives, and specifies its structure.

The first section of this chapter explains the potential of marketing tasks, such as market and customer research and product positioning in new product development. These activities ensure that new products will satisfy customer needs and are efficiently introduced into the market. In contrast, the second section argues that marketing activities can also hurt new product development performance because they distract attention from really new products opportunities and steer away from unserved, but potentially attractive, market segments. The third section examines this contradiction in more detail. It uses an organizational learning perspective and distinguishes between two types of market learning: exploration and exploitation. It argues that really new product development projects need a combination of both and that managers should explore the tension between them and thereby tap the potential for organizational renewal. However, it is also argued that this is a complicated task and that more research is needed to gain insight into this matter. Subsequently, this chapter presents the research aim and question that have initiated the research, the theoretical contributions and its managerial relevance. Finally, the last two sections provide the research approach and outline of the book.

1.1 The potential of marketing activities in product development

Consider the following well-known product development examples:

> 'In 1994, Unilever launched its new product 'Persil Power' across Europe. It was based on a major technological breakthrough and the company had spent more than 10 years and millions of Euros on development. The product used a new catalyst which Unilever claimed washed whiter at lower temperatures. Although the company had test marketed the new product, reports by Proctor and Gamble, Unilever's main competitor, and the British Consumer Association found that under certain conditions Persil Power significantly damaged clothes. After several unsuccessful attempts to counter negative press, Unilever was forced to withdraw the new product.
>
> In hindsight one of the main reasons for this failure was bad product testing and positioning. Unilever did most of its product tests in The Netherlands and Dutch people typically separate their white fabric from their colored ones and tend to read washing instructions. In contrast, consumers from southern Europe tend to wash all fabrics together at a hot temperature irrespective of any instruction. The newly developed catalyst acted fine at lower temperatures for white fabric only, but reacted with certain dyes at higher temperatures. Additionally, Persil Power was positioned as a general detergent suitable for all fabrics. However, in practice it was a niche product only effective for white fabric at low temperatures' (Tidd et al. 2001: 173).

'In 1975, Sony introduced its BetaMax format in the emerging VCR market. It was the first compact, lightweight inexpensive VCR with a recording capacity of one hour. Sony's goal was to set the standard in this market. In several ways BetaMax was technically superior to the competitive VHS format. It had a broader carrier signal band width and also a higher signal to noise ratio. However, in standard setting the format was defeated by VHS. One of the most important reasons proved to be the total absence of market research when developing the format. When potential partners conducted their own market research they found out that Betamax's superior technology was not critical. What consumers really wanted was a minimum tape capacity of two hours before considering a purchase. This need could be met by VHS (6 hour capacity) but could not be provided for by BetaMax (1 hour capacity)' (Cohen 1989; Cusumano et al. 1992).

The abovementioned examples clearly show that carrying out sufficient marketing activities in product development can be critical for new product effectiveness. Although this understanding can not be emphasized enough, it certainly did not pass by many managers and students of business. Both gurus and academics time and time again emphasized to stay in touch with the market when innovation is high on the agenda. As far back as 1959, Peter Drucker (1959: 39-40) already boldly declared that organizations have only two basic functions: innovation and marketing. Today, it is almost self-evident that through ongoing monitoring of customer needs and the use of the resulting knowledge in new product decision-making firms effectively renew themselves. Scholars often capture this behavior by the concept of *market orientation* (Day 1994a; Kohli and Jaworski 1990; Narver and Slater 1990). A recent meta-analysis on the subject (Kirca et al. 2005), reviewing dozens of earlier studies, confirmed that a firm's market orientation positively affects its new product effectiveness. Deeper analyses revealed that a market orientation positively influences the creation of new products, and that these new products enable the organization to meet the evolving needs of customers, thus influencing customer loyalty and the perceived quality of a firm's products.

Findings from product development scholars are in line with those of their marketing colleagues. Already in the late 1970s, Cooper (1979) concluded that a strong market orientation was one of the controllable factors that contributed to new product success. Several important product development studies echo these findings. In their meta-analysis, Montoya-Weiss and Calantone (1994) conclude that the proficiency of marketing activities during the product development process has a strong positive effect on new product advantage. In a similar vein, the literature review of Brown and Eisenhardt (1995) argues that a significant number of studies highlight the importance of customer involvement for the effectiveness of product concepts and better product designs. According to Cooper (2001) a failure to build in the voice of the customer, a poor competitor analysis, and limited understanding of market trends are common weaknesses found in many studies on new product failures. As Leonard (1995: 177) indicates, it seems that no information is more important to a firm 'than information flowing in from the market, as this information shapes science into commercial product or service'. Contrary to general expectations, a market orientation may also improve product development efficiency (Burchill and Fine 1997; Cooper and Kleinschmidt 1994a). For example, based on analyses of data from 103 product development projects from the chemical

industry, Cooper and Kleinschmidt (1994a) found that including a customer viewpoint into the new product process did not increase but actually reduced product development cycle time.

1.2 The risk of marketing activities in product development

The last section made clear that significant evidence points to marketing activities enhancing new product performance. However, controversy remains. Several studies warned for the potential risk of a market focus for innovation purposes.

Already in the 1970s and 1980s, Tauber (1974), Bennet and Cooper (1981), and Hayes and Abernathy (1980) claimed that fanatically putting the spotlight on customers could reduce the firm's competence to develop really new products. An important argument is that asking customers to express their needs will not generate truly new product ideas and restricts product innovation to incremental product updates. According to Shanklin and Ryans (1987), asking customers for input in generating really new product ideas has limited value because customers do not always have explicit needs for a product until it is introduced into the market. Customers seem to have limited capabilities to see through the eyes of firm technologists and do not know what solutions, functions and enhanced features a technology might offer (Leonard 1995). Hamel and Prahalad (1994) notice that customers have limited capacities to envision really new products and seldom asked for products that eventually became essential. An example is the mobile phone. Although there was a clear need for mobile communication in remote areas, it took a second generation mobile phone system before the average customer started to envision how the technology would benefit them.

Furthermore, since market segments only represent a fraction of the total market (Day 1999), organizations paying close attention to current customers and market segments may miss out on emerging technologies that are at first sight only attractive to non-customers or small unserved market segments, but eventually make their products obsolete. A well-known example is the disk drive industry. Christensen and Bower (1996) have shown how leading firms in the technology that dominated this industry at a certain point in time, systematically lost their leadership when new technology came about. It is argued that this happened because too much emphasis was placed on needs expressed by existing customers when allocating investments for product development. On the contrary, winning companies took risks and invested resources in really new projects that did not seem to have great initial market potential but proved to be products that later dominated the market. The losing companies listened too carefully to their customers and were trapped by 'the tyranny of the served market' in which managers see the world only trough their current customers' eyes (Hamel and Prahalad 1994: 83). Christensen (1997), in his award-winning book, subsequently examined a variety of other industries for which he identified the same pattern. The same reasoning applies for technological capabilities that are already available inside the firm. Danneels (2007), for instance, illustrates how difficult it was for a chromatography firm to apply its existing technology in new market spaces, because resource allocation was mainly based on current customers' needs.

Is seems that on the one hand ongoing monitoring of customer needs and market conditions and the use of the resulting knowledge in new product decision-making enhances new product

performance while on the other hand these same marketing activities may hinder the process. How to make sense out of this contradiction?

1.3 Exploitation and exploration in market learning

A closer look at marketing activities in new product development can bring some clarity. In doing so, we will draw upon the literature on organizational learning, specifically the seminal concepts of *exploitation* and *exploration* introduced by James March (1991). Although the work on organizational learning shares several similarities with market orientation (Bell et al. 2002), it offers additional insights that can enrich the latter concept (Jaworski and Kohli 1996). Consequently the use of an organizational learning perspective in the marketing field is not uncommon (Atuahene-Gima 2005; Baker and Sinkula 1999a; Day 1994b; Moorman 1995; Sinkula 1994; Slater and Narver 1995).

While organizations need to learn through experience, refining and using their existing knowledge base, they also need variety in experience by experimenting with alternatives and new knowledge to ensure long-term viability. These two types of learning have been captured by the twin concepts of exploitation and exploration (March 1991: 71). Exploitation refers to activities such as refinement, choice, and implementation, while exploration captures elements such as variation, search, and experimentation. In the context of marketing activities in product innovation, exploitation in *market learning* refers to the organizational generation and use of market information pertaining to current customers, product domains, market segments, and expressed customer needs. In contrast, exploration in market learning concurs with discovering market opportunities by searching for latent, unarticulated customer needs and new market segments (Atuahene-Gima et al. 2005; Jaworski et al. 2000; Slater and Narver 1998).

Exploitation in market learning involves external market information which is largely restricted to the firm's preexisting knowledge base and experiences of current customers and market segments. It enhances the ability of product developers to effectively respond to existing customer problems, and to refine their products to better serve customer needs or increase efficiency (i.e. incremental product development). It may also have a positive influence on future product development projects through experience effects: increased familiarity with an existing operational domain increases absorptive capacity in this same domain (Cohen and Levinthal 1990; Levinthal and March 1993). A focus on current customers and their expressed needs makes future information search more predictable and its use in product development more reliable and less complex (Atuahene-Gima et al. 2005).

Exploration in market learning, in contrast, is about searching for market information that is new to the firm and takes the firm beyond the scope of current experiences. Focusing on new market and technology developments enhances the probability of finding new market information. This new information increases the problem solving capacity of product development project teams (Levinthal and March 1993). It may also challenge current beliefs, cause-effect relationships, and mental models of the market resulting in ideas for really new products and adaptations to shifts in the external environment (Atuahene-Gima et al. 2005; Day and Nedungadi 1994; Slater and Narver 1995).

Although it can be argued that really new product development is by definition a sole act of exploration, we will follow scholars claiming that both types of learning are necessary in this process (Atuahene-Gima 2005; Cheng and Van de Ven 1996; Danneels 2002; Katila and Ahuja 2002; Kyriakopoulos and Moorman 2004; McGrath 2001). The majority of really new product ideas combine knowledge resources that already reside in the firm with knowledge that is newly generated. In these cases, existing knowledge provides the necessary absorptive capacity to use new knowledge, and ideas are a synthesis between a problem and its solution where neither the problem nor the solution are new in themselves (Danneels 2002; Kogut and Zander 1992; Luo 2002). Still, even if really new product ideas are purely based on exploration, exploitation is needed as well: the newly generated knowledge has to be refined and developed to the extent that the product is ready for market introduction (Cheng and Van de Ven 1996; McGrath 2001). Hence, to successfully generate really new product ideas, develop the really new product, and introduce it into the market, it is maintained that organizations need to build up market knowledge that is new to the firm (i.e. exploration) *and* update the market knowledge base that was already developed (i.e. exploitation). Exploitation without exploration results in a narrow product development portfolio which is full of incremental new products but has no space for really new product development projects. Conversely, exploration without exploitation will result in a product development portfolio that includes a lot of really new product concepts but lacks refined market knowledge that is necessary to successfully introduce these concept into the market and capitalize on ideas. The two types of marketing activities fulfill complementary roles (Moorman and Slotegraaf 1999). Exploitation increases the impact of exploration by refining new knowledge and reaping its benefits. Similarly, exploration overcomes the inherent limitations of exploitation, such as lack of breakthrough learning and the inability of adapting to significant environmental changes.

1.4 Research aim and question

Although firms have to combine the two types of market learning to achieve success in really new product development projects, this remains a difficult task. Exploitation and exploration represent fundamentally contradictory project strategies and are associated with different and inconsistent mental models, skills and processes (March 1991; Van de Ven et al. 1999). Combining these two activities represents a tension between old and new. It embodies a struggle between the comfort of the past and the uncertainty of the future. While exploration results in variation, exploitation benefits the selection and retention stages of the learning cycle (Zollo and Winter 2002). As such, market learning in really new product development projects presents a learning paradox: the simultaneous presence of contradictory elements (Lewis 2000; Poole and Van de Ven 1989; Quinn and Cameron 1988).

As both activities need scarce resources and attention these inconsistencies and their associated contradictory logics create organizational challenges (Atuahene-Gima 2005; Brown and Eisenhardt 1997; Christensen 1997; Duncan 1976; Gibson and Birkinshaw 2004; Sheremata 2000; Tushman and O'Reilly 1996). Whereas exploitation is rooted in variance decreasing activities, disciplined problem solving, and the organization's past, exploration is about variance increasing activities, learning by

doing, and looking into the future. Researchers of organization have pointed out traps that firms can fall into if they, consciously or unconsciously, ignore these learning paradoxes (Levinthal and March 1993; Miller 1992).

Inertia may cause organizations to get stuck in the past resulting in exploitation driving out exploration. Past success with existing organizational knowledge, skills, mental models, and project set ups increases the efficiency of further exploitation in similar domains. As a result 'organizations discover the short term virtue of local refinement and the folly of exploration' (Levinthal and March 1993: 106). Furthermore, managers often become risk averse in situations of gains (Kahneman and Tversky 1979). Since the returns from exploitation are typically more certain, closer in time, and closer in space than these from exploration (March 1991), exploratory experiments may suffer from lack of resources or even repression. This preference for exploitation may enhance short-term performance but eventually can result in a competence trap since firms may become incapable to respond to environmental changes (Christensen and Bower 1996; Danneels 2003; Hamel and Prahalad 1994; Tripsas and Gavetti 2000). Accordingly, highly specialized core competences may become core rigidities (Leonard-Barton 1992), or core incompetences (Dougherty 1995).

Although the more common situation for established firms is the one in which exploitation tends to drive out exploration, organizations can also be trapped in opposite circumstances. When exploration drives out exploitation, organizations suffer the costs of constantly renewing their stock of knowledge without reaping its benefits of exploiting them. Excessive exploration carries high risks and costs because there is a higher degree of inefficiency associated with a focus on new knowledge. Organizations may get caught in the failure trap in which they 'are turned into frenzies of experimentation, change and innovation by a dynamic failure' (Levinthal and March 1993: 105). Failure to exploit new knowledge leads to search for new knowledge which leads to failure to exploit and so on.

This research addresses dealing with the tension which results from combining exploration and exploitation in product development. Specifically, it takes an integral perspective on market learning in really new product development projects. It aims to *enhance our understanding of how firms organize the combination of both exploration and exploitation in market learning (i.e. resolve the market learning paradox) during the course of really new product development projects.* More formally stated it intends to answer the following research question:

> *'How do firms resolve the market learning paradox in the course of really new product development projects?'*

1.5 Theoretical contributions

By enhancing the understanding of how firms resolve the market learning paradox this research contributes to existing literatures in several ways. In our perspective, this research mainly contributes to the fields of (1) marketing organization, (2) organizational ambidexterity, and (3) market learning in product development.

An important theme in the organization of the firm's marketing function is the investigation into interdependencies among basic strategic orientations and organizational configurations, aiming at developing common configurations that lead to high performance. The underlying assumption is that the choice of configuration of the marketing organization depends on the challenges a firm faces. Workman and colleagues (1998), for example, argue that organizations should adapt the configuration of their marketing organization if the firm switches from a non-innovation oriented strategy to an innovation oriented strategy. Several conceptual and empirical studies on marketing organization inform us about the importance of making discrete choices between conflicting demands, and emphasize that there is no 'one best way' of organizing (Olson et al. 2005; Ruekert et al. 1985; Vorhies and Morgan 2003; Workman et al. 1998). However, as a consequence of operating at high levels of analysis these studies largely fail to inform us on how to develop a marketing organization that can deal with *multiple* conflicting and fluctuating contingencies such as the market learning paradox in product innovation projects. The tendency to focus on discrete either/or choices is further strengthened by the marketing discipline's bias towards using quantitative theory testing approaches that use well established either/or measures (Anderson 1994; Desphande 1983). Indeed, recent studies in the marketing field have called attention to the need for research on how firms actually organize for dealing with multiple contingencies in product innovation and benefit from it (Atuahene-Gima 2005; Atuahene-Gima et al. 2005; Kyriakopoulos and Moorman 2004; Slater and Mohr 2006). Additionally, Jaworski and Kohli (1993) suggest carrying out in-depth studies of a few organizations to develop deeper insight into the processes involved in achieving a market orientation, in order to complement the quantitative, correlation-based information provided by large-scale survey studies. This research responds to these research needs.

More than researchers in the field of marketing, scholars of organization have paid attention to paradoxical thinking and organizing for exploration and exploitation in innovation (Abell 1999; Eisenhardt 2000; Lewis 2000; Poole and Van de Ven 1989; Prud'homme van Reine and Dankbaar 2009; Quinn and Cameron 1988). Already in the 1960s and 1970s, Wilson (1966) and Duncan (1976) recognized the importance of combining and synchronizing seemingly contradictory organizational tensions. Duncan (1976) proposed that firms had to become *ambidextrous* if they wanted to deal with the conflict of both initiating and implementing really new product ideas inside their own organization. Ambidextrous organizations are complex organizational forms composed of multiple internally inconsistent architectures that are collectively capable of operating simultaneously for exploitation and exploration (March 1991; Tushman and O'Reilly 1996). Recently, the concept of organizational ambidexterity has gained momentum in research on organizations. The number of articles in several leading management journals that explicitly refer to organizational ambidexterity has increased from less than 10 in 2004 to more than 80 in 2009 (Raisch et al. 2009). Current syntheses of research on organizational ambidexterity has pointed to the notable use of the concept in the context of product innovation (Li et al. 2008b; Raisch and Birkinshaw 2008). Yet, organizational ambidexterity is still in the process of developing into a new research perspective in organization theory. Consequently, several aspects need further development. For instance, most of the studies that address the concept in the context of product innovation take the firm's total product

development portfolio as level analysis. From this perspective, exploitation is attributed to incremental new products while exploration is ascribed to really new products. However, tensions between old and new organizational knowledge and capabilities are often felt at a more detailed level (i.e. the single project instead of the product portfolio) (Leonard-Barton 1992; McGrath 2001). The engineers who developed BMW's new Rolls-Royce Phantom model, for instance, used elements that were taken from BMW's existing 7-series vehicles (i.e. exploitation) and components that were completely new to the firm (i.e. exploration) (Raisch and Birkinshaw 2008: 401). Furthermore, exploitation and exploration requirements may differ from project to project and have distinct implications for different organizational departments and functions (Danneels 2002; Gatignon et al. 2002; Kyriakopoulos and Moorman 2004). Instead of all-or-nothing recommendations, a more detailed analysis may reveal that different innovation contexts need different organizational configurations. As such, a project level perspective, as taken in this study, may complement studies that take the product portfolio as level of analysis. Additionally, the research on organizational ambidexterity has frequently taken a static viewpoint on organizational behavior, suggesting an ideal system state where exploitation and exploration is combined at a single point in time. Nevertheless, firms may need to continuously reconfigure their project set-ups to meet changing demands in internal and external contingencies (Lewis et al. 2002). For example, the combination of exploration and exploitation may be strived for by exploring at a certain period in time and then carefully shifting towards exploitation or vice-versa. As a consequence, managing the simultaneous pursuit of exploration and exploitation may thus be a task of dynamic rather than static alignment of organizational configurations (Siggelkow and Levinthal 2003). Recent research efforts have started to investigate how product development organizations are adapted in the dynamic context of product innovation (Westerman et al. 2006). Because this research takes a process perspective and looks into resolving the market learning paradox *in the course of* product innovation projects, it contributes to this emerging area of investigation as well.

As discussed before, the general relationship between market orientation and product innovation performance has gained widespread attention. However, the integration of market learning in the product development process has received far less consideration (Kok et al. 2003). The present study contributes to this field of inquiry by explicating what market knowledge resources are used in product innovation and what organizational mechanisms and structures facilitate their usage. Thereby, market knowledge will be unraveled in more detail than has been done in previous studies. By identifying four discrete market knowledge resources, it moves beyond the general dichotomy of knowledge on customer preferences and knowledge on the environmental forces that shape these preferences (Adams et al. 1998; Kohli and Jaworski 1990; Narver and Slater 1990; Veldhuizen et al. 2006). Besides focusing on the refinement and use of organizational market knowledge in product innovation, our research also addresses how product innovation can yield new market knowledge for the firm as well (Atuahene-Gima 2005; Danneels 2002; Srivastava et al. 2001).

1.6 Managerial relevance

Next to several theoretical contributions this research is also relevant for managers and policy makers. In our perspective, this managerial relevance largely boils down to insight into flexible organizational configurations to resolve the market learning paradox in product innovation.

It is almost axiomatic that in order to stay competitive, firms need to renew their product offerings. Consequently, it is not surprising that well respected firms have explicitly articulated product innovation strategies. In chemicals, for example, the Dutch life science and materials company DSM has appointed a Chief Innovation Officer and has set long term product innovation targets. Another example is Solvay. This Belgian chemical company has developed an innovation strategy where it has announced that 30% of the firm's income should come from new products or technologies developed within the past five years.

In earlier days, it was recommended that firms should be designed to focus on either incremental product updates and existing organizational knowledge resources or really new products and supplementing existing knowledge with new knowledge (Burns and Stalker 1961; Miller and Friesen 1986; Porter 1980). However, the globalization of markets, rapid technological developments and more sophisticated customer demands have shortened product life-cycles and changed business environments (Barczak et al. 2009; Wind and Mahajan 1997). Not just fast-moving, high-tech industries have been facing these changes, even industries that used to be relatively stable show increased speed of transformation (D'Aveni 1994; Eisenhardt and Martin 2000; Grant 1996a; Harreld et al. 2007). As a result, the need for really new products and therefore coping with the market learning paradox has increased for many firms. Surprisingly, few attempts have been made to come up with principles and guidelines that can help managers to deal with this tension and adapt to multiple contingencies. The majority of tools and advice have addressed either the exploitation or the exploration part without looking at the other. For example, while prescriptions such as Stage-Gate product development systems, Design for Six Sigma, and large scale customer surveys deal with the incremental refinement of current market knowledge and learning activities, they are less useful for exploration purposes (Benner and Tushman 2003; Leonard 1995). In contrast, creativity techniques, customer intensive market research, and organizational roles such as idea hunters and gatherers (De Bono 1995; Leifer et al. 2001; Leonard 1995) are useful for developing new market knowledge, but ill-suited for exploitation. As proposed by McKee (1992), firms that want to combine exploration and exploitation should develop additional skills and resources as well.

With large differences in new product success rates between firms (Barczak et al. 2009), and CEOs demanding that the marketing function should play a more active role in creating new organizational knowledge and product innovation (Webster et al. 2005) there is still sufficient room for improvement. Indeed, it appears that several leading institutions that bring together researchers and practitioners in the field of marketing still see research on organizing for product innovation and implementing marketing initiatives as important research priorities (ISBM 2009; MSI 2008). Detailed, action oriented, evidence concerning the way(s) firms are resolving the market learning paradox in product innovation is therefore highly relevant for contemporary managers.

1.7 Research approach

We answer our research question by using a qualitative multiple case study (Eisenhardt and Graebner 2007; Yin 1994). The use of this approach is appropriate for, at least, two reasons. First, this research studies a complex phenomenon (i.e. organizational learning) that takes place in a complex and dynamic social setting (i.e. product innovation in established firms). Looking into such multifaceted events benefits from using qualitative procedures by which event sequences can be clarified, overlapping causal factors disentangled, and contexts can be taken into account (Langley 1999; Lee 1999; Pettigrew 1990). Second, because there is little research on how firms resolve the market learning paradox in product innovation a primary motivation for this study is to contrast pre-existing understandings with observed empirical events to re-conceptualize and extend existing theories. For these purposes, the case study is an appropriate research strategy (Burawoy 1991; Yin 1994).

The research approach in this study consists of a literature review and an empirical study. The literature review covers three distinct streams of literature (i.e. product development, organizational knowledge and learning, and marketing) and integrates these into a conceptual framework. These streams of literature are chosen because they complement each other in a first attempt to frame the research problem. The literature on product development sketches a context in which market learning takes place. The works on organization knowledge and learning are used to detail dynamics in organizational knowledge, distinguish between exploration and exploitation, and identify supporting organizational structures. Finally, research in the field of marketing is used to specify the knowledge flows between the organization and the external market environment and their organization.

The empirical study is guided by the conceptual framework and is carried out in the context of the chemical industry. Although the choice of a single industry limits the generalizability of the results, it also reduces problems that arise when sampling from different industries. Different industries increase extraneous sources of variance which have to be controlled for when examining firm level phenomena (Bass et al. 1978). The main unit of analysis in our study is the product innovation project in a business unit of a chemical firm. However, product innovation projects are not viewed as self-containing units of analysis, but as visible arenas for the interaction between old and new *organizational* market knowledge. Thus, dynamics in organizational resources are placed under a magnifying glass by studying market learning in product innovation projects. As Pettigrew (1990: 269) put it, the research focuses on both 'vertical and horizontal organizational levels of analysis and the interconnections between those levels through time'. The total sample consists of ten projects in six business units of six different chemical firms. Interviewing key organizational actors has been the main data collection method. These interviews have been complemented by archival data. The combination of interviews and archival data collection enables a rich understanding of the research phenomenon and provides the opportunity for data triangulation (Jick 1979; Schwenk 1985).

Although it might appear that the research has been a rather linear journey, in reality it went through several cycles of confrontation between theory and empirical data. Each iteration cycle directed us to additional empirical data and theory.

1.8 Outline of the book

The remainder of this book is constructed around two main parts and a concluding chapter.

Part I contains two chapters. Chapter two discusses the theoretical background that is relevant for framing the problem under study. It draws upon the literature on product development, organizational knowledge and learning, and marketing. Chapter three presents the conceptual framework that is used to guide the empirical study and is based on the literature that is discussed in chapter two.

Part II starts with presenting the methodological details of the empirical study in chapter four. It explains the choice of case study research as research strategy and looks deeper into the nature of this strategy and how it is used in this research. Also the characteristics of the research setting (i.e. chemical industry), case selection, data collection and coding, data analysis and presentation of the findings are discussed. Chapters five through eight present the results of the empirical study. Although the ten cases are analyzed individually, their description is constructed around their relative deviance from the underlying product/process technology and the market application of existing business unit products. Chapter five describes three projects in which project members develop new technology to target existing market applications (i.e. tech-discontinuities). Chapter six presents findings on four projects that target new market applications with existing technology (i.e. market-discontinuities). Chapter seven focuses on three projects that target new market applications with new technology (i.e. tech/market discontinuities). In chapter eight, the ten cases are cross compared.

Finally, chapter nine presents overall conclusions and a discussion. It also presents theoretical, as well as managerial implications. Chapter nine concludes with the limitations of the current research that provide meaningful opportunities for further research. Figure 1.1 (next page) presents the outline of the book

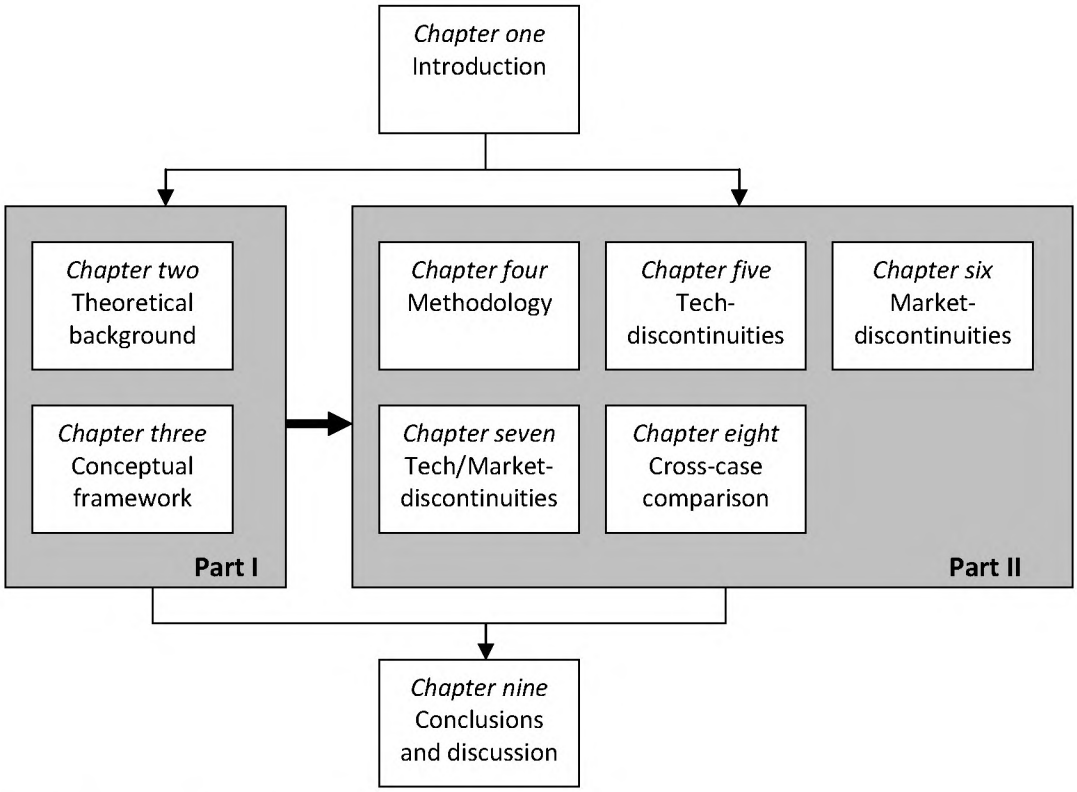


Figure 1.1: Outline of the book

Part I
Literature review

2 Theoretical background

The aim of this chapter is to build a foundation for developing the conceptual framework that will guide empirical analyses. This foundation will include literature on new product development, organizational knowledge and learning, and marketing. While each stream carries its unique perspective, together they provide the groundwork for answering the main research question. We will start by defining 'really new' product development. Then we will discuss research on the working strategy of the development organization and the nature of senior management involvement for successful 'really new' product development (2.1). Subsequently, we turn to a more detailed level of analysis and will discuss research on the organizational knowledge and learning processes that underpin new products. In this section we will also discuss organizational features that support these knowledge dynamics (2.2). The chapter ends with discussing research on the specifics of interacting with the market environment in product innovation and the management of this process (2.3).

2.1 'Really new' product development

Innovation research can be subdivided into two streams of literature (Adler 1989; Souitaris 2002). The first stream is a macro level, economics oriented tradition which studies differences in innovation across countries, the evolutions of technologies, and differences in innovation patterns within and between industrial sectors. Although this type of inquiry is very useful for sketching the context of product development in organizations, it regards the actual process of generating new product ideas and their development as black box (Brown and Eisenhardt 1995). The second stream of research, the product development literature, complements the first stream by opening this black box. Product development includes all activities needed to conceive, design, produce, and deliver a product to market.

Over the last 30 years, the product development literature has grown. Researchers have modeled the process and did in-depth analyses on specific parts and relationships. This paragraph will highlight some general findings from this second stream of literature to develop the background against which market learning in product development takes place. Because this research focuses on managing market learning in *really new* product development it particularly concentrates on contingent models of product development which distinguish between the magnitude of innovative change, or task uncertainty, between different product development projects.

A thorough analysis and a review of the literature on product development was undertaken by Brown and Eisenhardt (1995). These authors made the attempt to organize a broad selection of literature from 1969 until 1995, created an integrative model, and developed a sense of future research directions. Because their work is largely in line with other product development review studies (Cooper 2001; Henard and Szymanski 2001; Krishnan and Ulrich 2001; Montoya-Weiss and Calantone 1994), we will use this study as point of departure. In their analysis, Brown and Eisenhardt (1995) found that the literature they studied could be subdivided into three streams: product development as rational plan, communication web, and disciplined problem solving. Each stream,

they argued, involves a pattern of cumulative studies using the same theoretical perspective and research methods evolving from one or two pioneering studies. The rational plan stream builds on the work of Myers and Marquis (1969) and the SAPPHO studies (Rothwell 1972; Rothwell et al. 1974). This stream is primarily exploratory and a-theoretical. Because of its broad-based perspective it helps to define a wide range or relevant factors in product development. The communications web stream is based on the work of Allen (1971; 1977). Theoretically, this work is based on information processing and the resource dependency perspectives. Finally, the problem-solving stream is based on the work of Imai and colleagues (Imai et al. 1985), who studied the development of successful Japanese products. This stream of research takes the theoretical perspective of information processing one step further to problem solving strategies.

Brown and Eisenhardt (1995: 366) argue that 'the overlapping and complementary focal interests as well as the theoretical complementarities suggest that the three streams of literature are ready for synthesis into an integrative model'. In developing this model, they recognize that there are multiple agents whose actions influence new product performance. Specifically they argue that (a) a development organization[1], senior management, and suppliers affect new product process performance (i.e. speed and productivity of product development), (b) a development organization, customers, and senior management affect product effectiveness (i.e. the fit of the new product with firm competences and market needs) and (c) the combination of an efficient process, an effective new product, and a market that is large, growing and involves limited competition shapes the financial success of product development (i.e. revenues, profitability, and market share).

One of the further observations of these authors is that the contingent nature of product development such as the impact of the magnitude of innovative change, or task uncertainty, is not well understood. Such a contingency perspective is important for our theoretical background because the market learning paradox is only apparent in situations of really new product innovation. The next sections explicitly deal with organizational differences based on the extent to which product development is simple, repetitive, and predictable. These are structured around two important agents in the innovation process as identified by Brown and Eisenhardt (1995): the development organization and senior management. The two other important agents, suppliers and customers, are not included for different reasons. Suppliers are less interesting for answering the research question and customers are discussed when research in the field of marketing is addressed. This section is concluded with a summary.

New product development under high task uncertainty

Since the 1960s, a growing literature has both documented and attempted to explain organizational variation. Its starting point was a series of research studies which called into question the basic, sometimes implicit, proposition of classical theories of organization that there was 'one best way' to organize regardless of circumstances (Brech 1957; Fayol 1949). These studies showed instead that organizational forms varied in different circumstances. This line of reasoning has led to contingency

[1] A development organization may include project members and a formal or informal project leader.

theory which seeks to explain why this variation occurs. Contingency factors, such as environmental uncertainty (Burns and Stalker 1961; Lawrence and Lorsch 1967) and type of employees (Mintzberg 1979) are regarded as causal, independent variables and the elements of organizational configurations as dependent variables. The influence of contingency factors on organizational elements is mediated by the nature of the work to be organized (Donaldson 1996). A number of intermediate variables have been identified: interdependence of work processes (Thompson 1967) organizational strategy (Chandler 1977), and information processing (Galbraith 1973). Donaldson (1996) argues that these intermediate variables largely boil down to 'task uncertainty' or the extent to which work tasks are simple, repetitive, and predictable.

There is also a long history of contingent approaches to the organization of innovation (Burns and Stalker 1961; Hage and Dewar 1973; Perrow 1971). However, it is only more recently that empirical research has explored the detailed characteristics of organizing product development with varying levels of novelty resulting in various levels of task uncertainty. To distinguish different levels of novelty, several new product categorizations can be found in the literature. Such typologies are relevant for research and practice, but it is important to note that categories are not completely objective. It is critical to distinguish between relative and absolute measures of novelty (Garcia and Calantone 2002; Tushman and Smith 2002). What is relevant when answering our research question is how close a product innovation project is to existing firm skills and past experiences, which is a relative and not an absolute matter. Clearly what is an uncertain project for one firm may be a small step for another. For example, the development of a new electronic control unit might be considered as a low uncertainty project in an electronics firm, but a much higher uncertainty project for a machine tool manufacturer (Tidd and Bodley 2002: 129). Product development literature typically distinguishes between two levels of novelty. Product innovation with a low level of novelty (or task uncertainty) is often referred to as 'incremental' product development. Projects in this category focus on the incremental improvement of existing products for existing markets, using current firm technologies, market positions, and channels (Kyriakopoulos and Moorman 2004). Product development with a higher level of novelty is identified with labels such as 'discontinuous', 'radical', 'new-to-the-world' or 'really new' product development. Firms use this type of projects to move beyond current product/market linkages and focus on new organizational knowledge. In these cases, higher novelty and task uncertainty may come through two major sources: newness in market and/or technology (Abernathy and Clark 1985; Garcia and Calantone 2002; Tushman and Smith 2002). We will use the term 'really new' product development for the 'higher level of novelty' category of projects throughout this research.

2.1.1 The working strategy of the development organization

In complex and mature organizations, product development is performed by employees from multiple functions such as research, marketing, and manufacturing. Subsets of individuals from these functions form emergent organizations that might or might not have well marked boundaries. Following Sheremata (2000: 392), we refer to these as 'development organizations'. A development organization includes all individuals and groups working directly on the development of a particular

product. They form a product innovation micro-context and can be considered as 'organizations *within* organizations' (House et al. 1995; Shenhar 2001). Development organizations include the employees who actually do the work of product development and transform vague ideas, concepts, and product specifications into the design of new products. In this section we will discuss some research which argues that the appropriate characteristics of the working strategy of the development organization are contingent on the task uncertainty, or innovativeness, of the product innovation project under consideration.

Product innovation projects can be described as a collection of tasks that has to be performed by the development organization. For the purpose of organizing and structuring this work different process models have been described. Clustering project tasks into process stages gives a common and practical format for discussing problems and solutions. In table 2.1 (next page) an overview of several process models is presented and synthesized. As can be seen, the basic progression of activities is rather similar. Most of the models start with a planning phase and end when a product is introduced into the market. While the process models of table 2.1 break down product development work into four to thirteen tasks, some studies distinguish between a smaller number of stages, each with several subtasks and decisions (Cooper and Kleinschmidt 1986; Hauser et al. 2006). For example, in their study of product development expenditures, Cooper and Kleinschmidt (1986) studied 13 commonly cited activities and divided them into three major phases: predevelopment, development, and commercialization. More recently, the Product Development and Management Association (PDMA) has organized its 'body of knowledge' around the same three product development stages: discovery (the front end), development (the middle), and commercialization (the back end). Following this reasoning, this chapter synthesizes product development project tasks into three main types of activities: initiation, development, and commercialization.

Brown and Eisenhardt (1995) observed that the working strategy of the development organization is mainly discussed in the rational plan and the disciplined problem solving research streams. Both streams see product development as a complex problem solving task that can be rationalized. They advocate extensive planning before a disciplined execution of development and commercialization is carried out. Planning reduces uncertainty and therefore improves the speed and productivity of the development process by eliminating extra work, ordering the steps of the process, and avoiding errors.

Table 2.1: Product development; three main phases

Booz, Allen and Hamilton (1968)	Cooper and Kleinschmidt (1986)	Urban and Hauser (1993)	Song and Montoya-Weiss (1998)	Veryzer (1998a)	Crawford and Di Benedetto (2005)	Three main phases
Exploration	Initial screening	Opportunity identification	Strategic project planning	Dynamic drifting	Opportunity identification and selection	Initiation
Screening	Preliminary market assessment		Idea development and screening	Convergence	Concept generation	
Business analysis	Preliminary technical assessment		Business and market opportunity analysis	Formulation	Concept/product evaluation	
	Detailed market study			Preliminary design		
	Business analysis					
Development	Product development	Design	Technical development	Evaluation preparation	Development	Development
Testing	In-house product testing	Testing	Product testing	Formative prototype		
	Customer tests of products			Lead user testing		
				Design modification		
				Prototype		
Commercialization	Test market/trial sell	Introduction	Product commercialization	Commercialization	Launch	Commercialization
	Trial production					
	Pre-commercialization business analysis					
	Production start up					
	Market launch					
		Life cycle management				

Later research has nuanced these findings and introduced another problem solving logic. This logic represents knowledge structuring under higher task uncertainty as in the case of really new product development. When product innovation is highly uncertain, strictly separating planning from execution becomes problematic. Although some planning may still be favorable, the basic orientation is experimental. 'Probe and learn' is the main strategy rather than investing in accurate preliminary analyses. The underlying idea is that in these situations, where the product innovation outcome is largely unknown, it is not helpful to plan extensively. Rather maintaining flexibility and learning quickly through improvisation and experience yield effective performance.

Eisenhardt and Tabrizi (1995: 84), for instance, analyzed different strategies for speeding up the product development process. They proposed a compression strategy and an experiential strategy. Under the compression strategy product development is seen as a 'predictable series of well defined

steps'. The strategy for speed under this logic is rationalization and then squeezing the process by using supplier involvement, overlapping stages and computer aided design. In contrast, the experiential strategy regards product development as an 'uncertain path through foggy and shifting markets and technologies'. It is proposed that speed under this logic is achieved by quickly building understanding and options while maintaining focus and motivation, by using tactics such as multiple iterations, extensive testing and frequent project milestones. The authors gathered data from 72 product development projects in the global computer industry to test their strategies. Using a split-analysis, they found that the compression strategy was only effective in a more mature industry segment characterized by low uncertainty, while the experiential strategy was found to particularly shorten development cycle times in an uncertain industry segment. Comparable observations were made by Lynn et al. (1996), using a multiple case study including four successful innovative new product lines (such as GE's CT scanner). These authors found that the product development process in their cases was fairly different from the conventional, incremental process that follows a sequential linear pattern of planning and execution. The companies under study developed the products by probing potential markets with early versions of the product, learning from the probes, and probing again. The early product prototypes were not the result of a complete development process, but rather one of the initial steps. As Bobby Bowen, a key figure in GE's development of CT puts it (Lynn et al. 1996: 26):

> 'Several cases have been written about the history of CT, but they don't describe anything that I recognize. They tend to project what ought to have been rather than was. There is a tendency to assume that a lot more occurred by planning than what actually occurred...In fact, one thing tended to follow from the next. There were a lot of curves on the road that we hadn't anticipated. We took things as they came. A lot of people think of product development as involving a lot of planning, but I think the key is learning and an organization's ability to learn.'

Moorman and Miner (1997) aimed to analyze in what conditions organizational improvisation, defined as the composition and the execution of action converging in the same time, is likely to occur and is more effective than separating planning from execution. The authors applied a longitudinal study and analyzed 102 action events in two innovation projects in two mid-sized firms. Results showed that organizational improvisation occurred moderately and that less task uncertainty decreased its incidence. Furthermore it was found that the data supported the concern that improvisation could reduce product effectiveness. However, results also indicated that higher task uncertainty can reduce negative effects and sometimes create a positive effect for improvisation. Song and Montoya-Weiss (1998) investigated the interplay between a product's innovativeness, the product development process, and the product's performance of 163 really new projects and 169 incremental projects in a high technology industry context. They found that planning activities were also important for projects with a higher degree of innovativeness. However, they also found different effects regarding the type of planning. Business and market opportunity analysis was counterproductive for really new products but increased the profitability of incremental new products. Conversely, improving the proficiency of strategic planning had a positive effect on the profitability of really new products, but showed a negative effect in situations of incremental product

development. Veryzer (1998a) asked himself if processes for really new projects differed from the general models. Drawing on data of eight in-depth case studies of projects in several Fortune 500 firms, he developed a descriptive model of the really new product development process, and offered insight into general requirements for effective management of these projects. The process for really new product development was more exploratory and less customer driven than the typical process. In all cases, prototypes were developed at a much earlier stage. Prototype construction supported product application formulation from emerging technologies, and preceded opportunity analysis, assessment of market attractiveness, market research and financial analysis. Finally, Salomo, Weise and Gemünden (2007) aimed to investigate, among other things, the effects of product development planning on the success (product effectiveness, process performance and financial performance) of really new product development projects. Drawing on project level data of 132 launched new products, these authors confirmed the findings of Song and Montoya-Weiss (1998) that strategic project planning enhances innovative product innovation performance. They also found that while detailed project planning showed no effect, project risk planning, also had a positive impact on really new product development performance.

2.1.2 Senior management involvement

Senior management involvement refers to organizational managers that are involved in strategic product planning, and the allocation and control of product innovation resources but are not, like project members, involved in day-to-day project activities. In most cases these managers belong to the top management team of the organization or are their direct reports (Brown and Eisenhardt 1995; Tushman and Smith 2002). Senior management *support and control* is critical for product development success. The importance of support is specifically recognized in the rational plan stream of research and well supported by empirical research (Brown and Eisenhardt 1995). By support these authors mean the provision of resources to the project team, including both financial and human resources. This support is essential to attract development organization members, gain project approval to go ahead, and provide the funding necessary to foster development efforts. As important as senior management support is senior management control (Brown and Eisenhardt 1995). Control is particularly essential for achieving superior process performance. It involves having a central vision necessary to develop and communicate a distinctive and coherent product concept and tracking progress of work. At the same time, it is argued that control should be carried out subtly. It should also include delegation by senior management to the development organization so that they have enough autonomy to be motivated and creative. While the emphasis on subtle control stems from the problem solving research stream, Brown and Eisenhardt (1995) also argue that its theoretical link with performance is blurred and lacks rigorous empirical examination. For example, previous research is vague on how the responsibilities of senior management differ from the responsibilities of development organizations. Recent research efforts have brought supplementary insights regarding the topic and have identified some differences in beneficial support and control responsibilities of senior management. In these studies the level of innovativeness was included as a contingency factor.

For instance, a study by Swink (2000) investigated to what extent technological innovativeness moderated the effect of senior management support on product development goal achievement. A survey of 136 product innovation projects drawn from firms representing most of the major U.S. manufacturing industries provided data for the study. Senior management support was measured by the degree to which very explicit project objectives and goals were used, to what extent resources were adequate to make the project a success, and to what extent senior management was committed to making the project a success. Overall results showed that senior management support was positively associated with better time based performance, design quality, and financial performance. However, a significant interaction effect suggested that high levels of senior management support were ineffective in securing good financial performance of highly innovative projects. In speculating on this result the author discusses the possibility that what begins as senior management support can actually manifest itself as senior management interference. In turn, senior management interference might be specifically detrimental in high technology innovative projects because inexperience with new technologies increases the likelihood that senior management's situation assessments are incorrect. Another explanation could be senior manager's over optimism in situations of really new product development (see also Schmidt and Calantone 1998). If managers find it more difficult to 'pull the plug' on really new projects, then they are likely to support a greater percentage of 'bad projects'. For incremental product development projects senior management is likely to be more objective and less prone to support projects with poor financial prospects. An interesting study in the context of senior management involvement was performed by Bonner and colleagues (2002). These authors investigated the relationship between product development control mechanisms used by senior management and product development performance. The study also aimed at capturing possible moderating effects by the project's level of innovativeness on the relationship of several control mechanisms and performance. Based on prior research, six types of relevant project control mechanisms were included: process control, output control, development organization-based rewards, development organization's strategic control influence, development organization's operational control influence, and management intervention. A survey instrument was used resulting in sufficiently complete data on 95 projects from a diverse set of organizations. Overall the findings suggest that while project teams need some level of direction concerning the objectives to be accomplished and the procedures to be followed, senior managers can exercise too much control. Specifically the findings showed a significant negative association between the use of formal process control and project performance. The findings also indicated that the degree to which senior management intervened in project-level decisions during product development was negatively related to project performance. However, results also supported the notion that early and interactive decision-making on control mechanisms is important for effective projects. Specifically early involvement of both development organization members and senior management in setting operational controls, such as goals and procedures for monitoring and evaluating the project, was positively associated with performance. Contrary to other work, these authors did not find significant support for the moderating role of the level of innovativeness on the relationship between formal process and output control, respectively, and project performance. A study by Cardinal (2001)

examines the impact of organizational wide formal controls on innovativeness at the firm level. Drawing on a database of 57 pharmaceutical firms or business units that was compiled by using archival and questionnaire data this author tested the relationships between three types of formal controls and two categories of innovative outputs. The types of formal control included input control (e.g. professionalization and specialist diversity of R&D members), behavioral control (e.g. formalization of procedures), and output control (e.g. emphasis on patents and new drug introductions). The two innovative categories were incremental new products in the form of drug enhancements and really new products in the form of new drugs. Results showed that input, behavior, and output control enhanced really new product performance and that input and output control enhanced incremental new product performance. Although the similarities between organizational level controls may interact with actual differences for individual projects, and a single industry context might limit broad applicability, the study illustrates that some dimensions of formal control are relevant for product development in general, regardless of its level of innovativeness. A study by Lewis and colleagues (2002) explored the effects of using contrasting project management styles on the effectiveness and efficiency of product development projects. In their study the authors included an emergent style and a planned style. An emergent style facilitates project member creativity, flexibility, and improvisation, while a planned style is more formal and centralized, including management discipline and direction setting. They also investigated to what extent project task uncertainty moderated the proposed relationships. By using a multiple panel approach of collecting survey data on several points in time, the authors studied 80 projects in one chemical company over a maximum period of two years per project. The findings indicate that the use of a paradoxical blend of both styles enhances overall project performance. The results on the moderating effect of task uncertainty were quite complex. Among the findings was that in situations of increasing technological uncertainty it appeared that the planned style and specifically formal reviews by senior management increased in importance for project effectiveness. In situations of high market uncertainty it appeared that planned style elements such as formal monitoring of milestones and directive control slowed the development process. On the contrary, participative control, which fits the emergent style, benefited project effectiveness in situations of high market uncertainty. Finally, Sethi and Iqbal (2008) researched the effect of rigorous formal product development process control on new product financial performance. They also analyzed how this relationship was moderated by product innovativeness. 'Formal product development process control' was put into operation by specifically focusing on the widely embraced Stage-Gate process (see e.g. Cooper 2001), which combines formal process and output control mechanisms. Stage-Gate controls break the traditional product development process into a set of discrete and identifiable stages with each stage consisting of a set of prescribed activities. The stages are separated by gates, which serve as control and go/no-go check points. Gates are often designed in the form of meetings that take place between senior management and representatives from the development organization. Using a survey instrument, the authors gathered data on 120 projects from a wide variety of industries in which a Stage-Gate methodology was used. They found a positive linear effect of project gate review criteria 'strictness', 'objectivity', and 'frequency of evaluation' on project

inflexibility. These effects were not mitigated when a certain level of relaxation in gate evaluation (gate conditionality) was applied. In turn, project inflexibility was positively related to project learning failure. Finally, project learning failure adversely affected the financial performance of projects with a high level of innovativeness. Based on their study the authors argue that recent suggestions of making the Stage-Gate process more conditional for mitigating some of the unintended consequences of rigorous gate evaluations is not effective. They think it is better to create separate control mechanisms for incremental and really new product development projects, along with separate gate review committees. Additionally they admit that it is not always possible to come up with a set of standard criteria for evaluating all types of really new product development projects. As a possible solution they suggest senior managers to involve members of the development organization in modifying standard criteria to accommodate project specific needs.

Overall the results of the studies suggest that senior management support is generally beneficial for really new product development, however Swink's (2000) study shows that it can also have negative implications. Additionally, formal control mechanisms used by senior management can be beneficial for both incremental and really new product development, under the conditions that the development organization is involved in specifying them and that they are tailored towards the specific product development project needs stemming from its level of innovativeness.

2.1.3 Summary

To develop a perspective on the context in which market learning in really new product innovation takes place, this section specifically focused on reviewing empirical studies on aspects of successful product development that explicitly include the level of innovativeness as a contingency variable. These aspects were structured around two important organizational agents (i.e. development organization and senior management) in the innovation process as identified by Brown and Eisenhardt (1995). Table 2.2 presents a summary of the findings.

Table 2.2: Aspects of successful product development; really new vs. incremental projects

Aspects	Really new projects	Incremental projects	Illustrative literature
DEVELOPMENT ORGANIZATION *(working strategy)*	'Three main product development phases; Learning by doing: Some planning, but basic orientation is experimental; 'Probe and learn' is the main strategy rather than investing in accurate preliminary analyses'	'Three main product development phases; Learning before doing: Extensive planning and disciplined execution of development and commercialization'	Eisenhardt and Tabrizi (1995); Lynn et al. (1996); Moorman and Miner (1997); Song and Montoya-Weiss (1998); Urban and Hauser (1993)
SENIOR MANAGEMENT *(support and control)*	'Support generally beneficial but can have negative implications; Formal control mechanisms used by senior management beneficial, under the conditions that the development organization is involved in specifying them and they are tailored towards the specific needs of a *really new* project'	'Support generally beneficial; Formal control mechanisms used by senior management beneficial, under the conditions that the development organization is involved in specifying them and they are tailored towards the specific needs of an *incremental* project'	Swink (2000) Bonner et al. (2001); Cardinal (2002); Lewis et al. (2002); Sethi and Iqbal (2008)

This overview presents preferable management practices for really new product development and how they differ from the ones that suit its incremental counterpart. In the underlying studies, really new product development is seen as a set of rather homogeneous inter-functional activities aiming at developing products that move beyond current product/market linkages. However, if we take a closer look this homogeneity seems to disappear. From a more detailed perspective, really new product development is a term that is used to describe activities that may differ from project to project and have distinct implications for different organizational departments and functions. Some really new product development projects, for instance, require a state of the art research department because their newness may lie in developing a path-breaking technology. In contrast, other projects may use an established product and might need entrepreneurial marketing managers to launch it in an emerging market segment. Finally, a third group of project might need both. Consequently, if we want to arrive at a detailed perspective on resolving the market learning paradox in really new product development projects we have to add scholarly work that details differences in activities in really new product development projects. A way to do so is to extend the theoretical perspective of product innovation as information processing and see it as the creation and integration of specific organizational knowledge resources (Madhavan and Grover 1998).

2.2 Organizational knowledge and learning in the context of product innovation

As was illustrated in the last section, the underlying theories of the work on product development discussed in the review by Brown and Eisenhardt (1995) stressed the importance of information. As knowledge can be seen as 'information in context' (Nonaka et al. 2000) this chapter will focus on organizational knowledge and learning processes underlying product innovation. More specifically,

we will look at product innovation through the lenses of the knowledge based view of the firm that argues that the capability to create and utilize knowledge largely defines an organization's ability to develop new products. Successively, we will discuss work in the fields of organizational knowledge and organizational learning and relate this to product innovation. This theoretical discussion will be concluded by a summary.

2.2.1 Knowledge as organizational resource

The resource based view of the firm (RBV) considers knowledge as an important resource of organizations (Amit and Schoemaker 1993; Barney 1991; Dierickx and Cool 1989; Grant 1991; Peteraf 1993; Wernerfelt 1984). Within the RBV framework it is assumed that firms are bundles of different resources, that these resources are heterogeneously distributed across firms, and that resource differences persist over time. Based on these assumptions, RBV researchers have theorized that when firms have resources that are valuable, rare, inimitable, and non-substitutable they are able to achieve sustainable competitive advantage by implementing value creating strategies that cannot be easily duplicated by other firms. In this context, resources include physical assets, capabilities (or competences), organizational processes, and knowledge controlled by the firm (Barney 1991). Amit and Shoemaker (1993) make a subsequent and widely adopted addition by distinguishing between resources, being tradable and non-specific to the firm, and capabilities as being firm specific and used to utilize the resources within the firm. Later work on dynamic capabilities and the knowledge based view of the firm has extended RBV thinking.

Extending RBV: Dynamic capabilities

The increasing dynamism in the firm environment with its frequent and rapid changes in technology, customer preferences, and competition, has caused researchers to question the sustainability of superior performance of a given strategic position and bundle of resources (D'Aveni 1994; Eisenhardt and Martin 2000; Grant 1996a; Harreld et al. 2007). It was doubted that understanding superior performance at one point in time would explain how superior performance is consistently achieved over time. Addressing this thought, RBV thinking has been extended with the dynamic capabilities perspective. This perspective focuses on the capacity of an organization facing a changing environment to create new resources or to renew and alter its resource mix. Teece et al. (1997), which is recognized as one of the first contribution developing explicitly the notion of dynamic capabilities (Ambrosini and Bowman 2009), defined these as the firm's ability to integrate, build, and reconfigure resources to address rapidly changing environments. Since its introduction, the concept has attracted increasing attention (Eisenhardt 2000; Helfat et al. 2007; Makadok 2001; Wang and Ahmed 2007; Winter 2003; Zahra et al. 2006; Zollo and Winter 2002). Ambrosini and Bowman (2009) argue that this accumulation of work has led to a consensus that dynamic capabilities are repeated organizational processes in the most general sense and that their role is to change a firm's resource base. Furthermore it is argued that dynamic capabilities are built rather than bought in the market, are path dependent and evolved over time, are embedded in the firm, and are a source of, at least, temporary competitive advantage.

Important to notice is that dynamic capabilities and 'ordinary capabilities' are distinct constructs in typologies of organizational capabilities. Collis (1994), for example, introduced a hierarchy in capabilities. The first category consists of those that reflect the ability to perform the basic functional activities of the firm, such as selling products more effectively than competitors. The second category of capabilities is grouped around the theme of dynamic improvement of firm activities, such as purposeful updating of the organizational knowledge base and incremental product development. The third category of capabilities, which is closely related to dynamic improvements, comprises the capabilities to recognize the intrinsic value of other resources or to develop novel strategies before competitors, such as the development of new knowledge resources and really new product development. According to Ambrosini and Bowman (2009), both the second and the third categories can be seen as dynamic capabilities in the view of the definition of Teece and colleagues (1997) because they relate to the modification, creation, and extension of the organizational resource base. Collis (1994) also identified 'higher order' or 'meta capabilities' which are necessary for learning to learn capabilities. This author argued that these meta capabilities can go on 'ad infinitum' and that there is a kind of infinite wave of capabilities to renew capabilities to renew capabilities, etc. Consequently, the value of organizational capabilities is context dependent and finding the ultimate source of competitive advantage is therefore impossible. Comparable typologies have been developed and used by researchers such as Winter (2003), Danneels (2002), and Zahra et al. (2006).

Extending RBV: Knowledge based view of the firm

Next to the dynamic capabilities perspective, the RBV has been extended by the knowledge based view of the firm (KBV). This extension also builds on the assumption of environmental dynamism. The KBV argues that organizational knowledge and its generation, transfer, integration, and application are the main organizational resources and capabilities because these are relatively more likely to be idiosyncratic to the firm in which they reside (Argote and Ingram 2000; Dierickx and Cool 1989; Grant 1996a; 1996b; Kogut and Zander 1992; Verona 1999). Connor and Prahalad (1996: 477) even go so far as stating that knowledge based resources are 'the essence of the resource based perspective'. While Teece (1982) argues that the existence of large diversified firms can be explained by the high transaction costs of their knowledge.

One of the earliest attempts to increase dynamics in the RVB and focus it in the direction of organizational knowledge was by Dierickx and Cool (1989). These authors conceptualized the knowledge of firms in terms of stocks and flows. Stocks of knowledge are accumulated knowledge assets, while flows are knowledge streams within and between organizations that contribute to the accumulation of knowledge. Superior stocks and flows are seen as sources of competitive advantage and superior performance. Kogut and Zander (1992) also emphasized the strategic importance of knowledge as a source of advantage. They posited that what firms do better than markets is the creation and transfer of knowledge. They argued that knowledge, in the form of 'know what' and 'know how' is held by individuals, and yet is also embedded in the organizing principles by which people voluntarily cooperate in organizational context. Because the creation of new knowledge depends on existing capabilities and organizing principles, the knowledge of the firm develops in a

path dependent way, through the replication and recombination of existing knowledge. The authors also argued that the ability to replicate knowledge determines the firm's rate of growth, but this replication also facilitates imitation by competitors. Therefore, organizations are able to grow and deter competitive imitation only by continuously recombining their knowledge and applying it to new market opportunities. Hence, in a competitive environment, superior performance can only be sustained through continuous (product) innovation. Finally, important contributions were made by Robert Grant (1996a; 1996b) who claimed that organizational knowledge is a source of sustained competitive advantage. In his view, the essence of organizations is their ability to integrate knowledge and apply it in innovation activities to develop new products and services. Yet, because this knowledge is possessed by organizational individuals and not the organization, a critical element of sustained competitive advantage is the ability to integrate the knowledge of organizational members. The author identified three characteristics of knowledge integration that he claimed increase its strategic value. The first one is the efficiency of knowledge integration which is a function of the level of common knowledge among organizational members, the frequency and variability of the organizational activity, and the organizational structure. The second is the scope of the integration, with a broader scope facilitating the creation and preservation of competitive advantage. The third is the flexibility of integration to include new knowledge and the reconfiguration of existing knowledge. In addition Grant pointed out that knowledge can also be integrated externally through relational networks that span organizational boundaries. These networks which can be used for accessing and generating new knowledge are specifically important in dynamic environments where the speed and scope of knowledge integration is paramount for sustaining competitive advantage.

Knowledge attributes

Considering knowledge as organizational resource has caused researchers to develop classifications, or taxonomies of knowledge, to examine the various strategies, routines, and techniques through which different types of knowledge are created, codified, converted, transferred, and exchanged (Tsoukas 1996). Despite the fact that knowledge in itself is inherently unobservable, which makes it difficult to distinguish it in an unambiguous manner (Spender 1996; Szulanski 2000), researchers have tried to develop classifications based on knowledge characteristics. A recent study by Turner and Makhija (2006) synthesized twenty-two highly cited papers that identify knowledge characteristics in problem-solving situations. These authors argued that a variety of knowledge characteristics, generally, can be captured by three attributes that represent important qualitative differences: *codifiability*, *completeness* and *diversity*. The authors discussed these attributes in relation to knowledge that relates to means, behaviors, or processes, by which organizational goals are accomplished (i.e. 'know how'), and the ends and outcomes of these processes such as knowledge on the market or technologies (i.e. 'know what')[2]. Because the exact value of the attributes can vary per problem-solving situation the combinations of the three knowledge attributes are potentially infinite, reflecting the potential heterogeneity in knowledge resources and capabilities

[2] This distinction mirrors the division between 'capabilities' (i.e. 'know how') and 'resources' (i.e. 'know-what').

between different entities (i.e. individuals, work groups, organizations, inter-organizational networks).

Codifiability refers to the extent to which knowledge can be broken down into specific components that are easily understood and articulated (Kogut and Zander 1992). This characteristic is widely used in the literature and is essentially based on the distinction made by Polanyi (1967) between explicit and tacit knowledge. According to this author, explicit knowledge is articulated and specified either verbally or in writing, while tacit knowledge is unarticulated, intuitive and non-verbalized. Explicit knowledge tends to be relatively unambiguous, observable, and indisputable. It can be readily transferred within organizations or between individuals without loss of meaning (Grant 1996b). In contrast, tacit knowledge is not easily codified or broken down into component parts. Therefore this knowledge is difficult to articulate or express. The ability to use tacit knowledge depends on the individual's prior experience and familiarity with the knowledge, which provides a base from which new knowledge can be understood more easily. To some extent, Polanyi's distinction is troublesome and differently interpreted among researchers. Some argue that tacit knowledge can be converted into explicit knowledge (Kogut and Zander 1992; Nonaka and Takeuchi 1995). Other authors see tacit and explicit knowledge as essentially distinct and complementary forms of knowledge. They argue that perception underlies the paradigm of tacit knowledge and that even in perceiving a simple object there are clues that cannot be specified. As Tsoukas (2003: 425) puts it: 'tacit and explicit knowledge are not two ends of a continuum but the two sides of the same coin; even the most explicit kind of knowledge is underlain by tacit knowledge'. However, while this last observation may hold, it can be argued that some knowledge is potentially more suited for display or manifestation (i.e. codification) than other knowledge.

The notion of *completeness* refers to 'the degree to which the knowledge for problem solving or completing tasks is entirely sufficient and available for the problem solver's use' (Turner and Makhija 2006: 199). Knowledge completeness mirrors task uncertainty in the sense that knowledge is likely to be less complete when decision situations are new, instable or unpredictable. These situations reduce the likelihood that it is known what knowledge is required in advance to achieve goals. The potential variations in the requisite set of knowledge will often lead to more complicated search processes (MacDonald 1995a), such as knowledge sources that operate external of the organization. In contrast complete knowledge reflects task certainty and implies that all knowledge necessary for making a decision is available. Note that tacit knowledge may still be complete to perform particular tasks (Turner and Makhija 2006). Consider the deep knowledge of special manufacturing techniques used by a worker in a custom-made Italian shoe company. The worker has complete knowledge to manufacture custom-made shoes even though it may be highly embedded in this individual.

Diversity refers to the number of parameters required to characterize the knowledge in question. This is also addressed in the literature as 'knowledge complexity' (Kusonoki et al. 1998; Winter 1987; Zander and Kogut 1995). Highly diverse knowledge may come from distinct and multiple functional areas or disciplines or incorporates multiple complementary dimensions linked to the decision situation.

Alternative perspectives on organizational knowledge

Next to the cognitive possession conceptualization of knowledge as a resource, which has been the dominant perspective of KBV, other viewpoints have emerged. Spender (1996) argues that a dynamic theory of the firm which is based on knowledge should not treat the concept as an 'ordinary' resource because it is not an observable and transferable commodity. In his view, the organization is not treated as a collection of rational agents. Rather it is argued that organizations learn and have collective knowledge and that the self identity of its members, meaning, and communication is influenced by the organization's evolving identity. The firm is seen as a system of knowing activity rather than a collection of knowledge resources that can be transferred across the organization.

Quite similar to Spender's thoughts is the constructionist, or social-process perspective on organizational knowledge (Blacker 1995; Brown and Duguid 1991; Cook and Brown 1999; Lave and Wenger 1991; Orr 1990). This perspective is descriptive in nature. It suggests that the treatment of knowledge as an ordinary resource is clearly incomplete. Authors in this stream advocate a more contextual, processual, and situated view of knowledge, with closer ties to organizational learning and social identity. This perspective proposes that reality is socially constructed or conceived and is based on social interaction. These social constructions involve plurality and diversity and come about through communication. In this view, a shift should take place from knowledge as a commodity that individuals and organizations may acquire to studying knowing as something that they do. It understands knowledge as a process, and for this reason it is called 'knowing'. It is always rooted in a context of interaction and acquired and applied through some form of participation. The firm is characterized as a 'community of practice' or 'activity system' where knowing is mediated by artifacts, and power relations and interests are key factors in the interpretation process.

Although our research will take a cognitive possession perspective which sees knowledge as an organizational resource, we recognize that knowledge is not an ordinary resource and that it can be adapted by interaction. Therefore we will avoid using the word 'transfer' which connotes that pieces of knowledge can be transferred from one place to the other while keeping the exact the same meaning.

2.2.2 Managing knowledge dynamics in product innovation

In addition to understanding knowledge and how it can become a source of competitive advantage, literature in this field has also studied the processes through which knowledge is managed. Thus besides discussing organizational knowledge's potential impact on competitive advantage and the nature and types of organizational knowledge this research also looks into knowledge dynamics and studies the micro-processes by which knowledge is generated or created, and integrated or used.

Including multiple levels and perspectives can result in a large number of distinct knowledge processes. For example, what for an individual is knowledge integration may be knowledge generation for an organizational group. Additionally, when studying knowledge processes at the group level, what is integration of current knowledge in the eyes of the sender may be the generation of new knowledge in the eyes of the receiver. For studying product development in

mature and complex organizations, we will take the perspective of the functional group and consider two important knowledge dynamics: *knowledge generation* and *knowledge integration*.

Knowledge generation is the process by which functional knowledge is updated or renewed. In this context, 'functional' refers to relatively fixed knowledge frames of groups in organizations that are the result of task partitioning and specialization (i.e. research vs. marketing) and the configuration of authority by hierarchy (i.e. project members vs. senior management) (Kusonoki et al. 1998; Schulz 2001). This knowledge may be created by organizational members through research or experimentation or generated via external sources through scanning, searching and inter-firm collaboration. It can occur either through systematic processes consciously engaged in by organizational members or as an unintentional by-product of other processes (Huber 1991). Knowledge integration refers to the dissemination of function specific knowledge to other functions in the organization and applying it in product development to create the new idea, the new prototype and, finally, the new product (Grant, 1996b) (Figure 2.1).

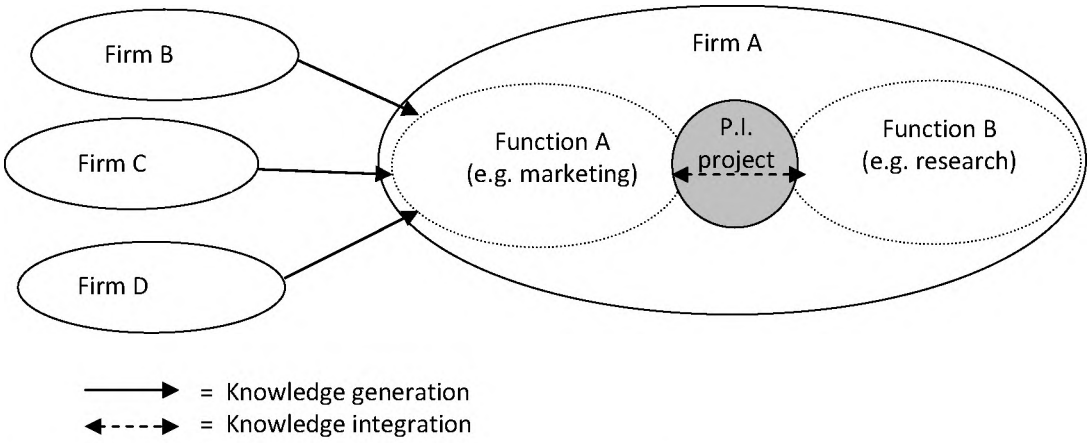


Figure 2.1: Knowledge generation and integration in product innovation (P.I.)

Knowledge dynamics in product innovation: the effect of social capital

To describe how dynamics in knowledge are influenced beyond the effect of knowledge attributes, we will use a social capital perspective. Given the social embeddedness of dynamics in organizational knowledge this perspective provides opportunities for systematic theoretical analyses (Nahapiet and Ghosal 1998). Because the social capital perspective uses networks of social actors to describe and analyze social affairs and productivity it is useful to identify a focal actor. Following the approach taken in the last section, the focal actor in our theoretical discussion will be the functional unit within the firm which is both involved in new product knowledge generation and integration. The impact of social capital on knowledge dynamics will be discussed by looking through the eyes of this network actor.

Although the social capital perspective is still in the early phases of its life cycle (Hirsch and Levin 1999), several organizational theorists have made attempts to develop overarching definitions and

integrative frameworks. Adler and Kwon (2002: 23) synthesized 19 definitions from a wide variety of fields resulting in the statement that 'social capital is the goodwill available to individuals or groups. Its source lies in the structure and content of the actor's social relations. Its effects flow from the information, influence and solidarity it makes available to the actors'. Social capital can be described as a resource that actors derive from specific social structures or from specific social relations. The ultimate value of social capital heavily depends on the task demands placed on the focal actor. What matters is the fit between the network and organizational goals (Krackhardt and Hanson 1993). Following authors such as Nahapiet and Ghoshal (1998) and Inkpen and Tsang (2005), social capital can be broken down into three distinct but interrelated dimensions: *structural, relational, and cognitive.*

From the perspective of the focal actor, the *structural* dimension of social capital reflects the level of connectedness, or who you can reach to generate and integrate knowledge (Burt 2000; 1992). The *relational* dimension of social capital refers to the strength of the relationship between the focal actor and other actors. Whereas the structural dimension primarily has its impact on the accessibility to actors, the relational dimension impacts the motivational aspect. Strong ties between actors reflect frequent contact, are usually long-term, reciprocal, and involve a strong degree of emotional closeness (Granovetter 1973). Actors rely on strong ties for advice and support, and are less reserved about making heavy investments in this type of relationship. Strong ties yield trust, norms, shared goals, and identification which support knowledge generation and integration (Hansen 1999; Inkpen and Tsang 2005; Nahapiet and Ghosal 1998). Opposed to strong ties, weak ties are temporal, transient and normally involve little emotional investment (Granovetter 1973). Weak ties also have their specific value in knowledge sharing and integration. Communication and idea exchange between actors that do not meet very often and know little about each other can provide new perspectives and provide new arguments for discussion. Although weak ties may hamper sharing ambiguous knowledge, investments in building them are often low and they can be a source of opportunity and new knowledge (Hansen 1999). The *cognitive* dimension of social capital refers to the representations, interpretations, and systems of meaning among actors. Although it is widely recognized that innovation happens through combining different knowledge resources and experiences, meaningful knowledge generation and integration requires at least some context sharing between actors (Moorman and Miner 1997; Nooteboom et al. 2007). Nahapiet and Ghosal (1998) identify that context sharing may come about through the existence of shared language and through the sharing of collective narratives. These provide a frame of reference for observing and interpreting the environment and therefore may provide a common context for evaluating the benefits of knowledge sharing. In turn, this facilitates actual knowledge generation and integration. Related to the cognitive dimension of social capital is the notion of *absorptive capacity* as coined by Cohen and Levinthal (1990). This prominent theme in the literature on knowledge sharing refers to the network actor's abilities to recognize, assimilate and apply new knowledge (Cohen and Levinthal 1990; Lane et al. 2006; Zahra and George 2002). It is used in the context of both intra-firm (Gupta and Govindarajan 2000; Szulanski 1996) and extra-firm (Lane et al. 2006) knowledge sharing. A prerequisite of absorptive capacity is at least some overlap of cognitive frames. As Cohen and

Levinthal (1990: 128) put it: 'the organization needs prior related knowledge to assimilate and use new knowledge'.

In short, social capital can thus be assumed to affect knowledge generation and integration by: providing access to actors with relevant knowledge or needs (structural); providing a common interest and an atmosphere of mutual trust and appreciation of the value of others' knowledge (relational); sharing a common ability that helps in understanding other actor's knowledge and as well as 'correct' interpretation and assessment of all knowledge (cognitive).

Facilitating knowledge dynamics in product innovation

Based on the argument that social capital plays a critical role in knowledge generation and integration, a set of organizational conditions can be proposed that influence actors' social capital and therefore has the potential to facilitate knowledge flows in product innovation (table 2.3).

Table 2.3: Conditions facilitating knowledge flows in product innovation

Social capital dimension	Intra-firm knowledge flow (knowledge integration)	Inter-firm knowledge flow (knowledge generation)
Structural Establishing connections	Personnel transfer between functions; Co-location; Decentralization of authority by senior management; Structural integration mechanisms; ICT infrastructure.	Boundary spanning function to establish and maintain external connections
Relational Enhancing tie strength	Clear and transparent interrelated reward criteria and incentive systems	'Shadow of the future'
Cognitive Developing shared language and narratives	Boundary objects	Boundary objects.

Personnel transfer and co-location between intra-firm actors (i.e. functions) establish additional connections on top of the more formal ties in which the latter are strengthened by the existence of the former (Griffin and Hauser 1996; Inkpen and Tsang 2005; Orlikowski 2002). Decentralization of authority enables functions to establish lateral ties on their own initiative. Because senior management approval is not always necessary, this mechanism changes the hierarchical network configuration in such a way that it facilitates timely sharing of ambiguous knowledge among network actors (Tsai 2002). Similarly, structural integration mechanisms such as integrating roles and departments, task forces and teams, and liaison roles change the network configuration in such a way that it enhances personal interaction and therefore the integration of knowledge (Grant 1996b; Griffin and Hauser 1996; Gupta and Govindarajan 2000; Moenaert et al. 2000). Although the contribution of the information and communication technology (ICT) infrastructure to knowledge

integration is a subject of debate, it can play a supporting role by influencing the network configuration. Van den Hooff and Huysman (2009), for instance, found that the presence of an effective ICT infrastructure influences the structural dimension of social capital by helping to show where knowledge is located and improving organizational connectivity. Inter-firm relationships are not part of an established hierarchical network. From the perspective of the firm installing boundary spanning functions enhances the opportunity that it develops external connections providing access to external knowledge (Rowley et al. 2000; Tushman 1977).

It is argued that intra-firm networks are social structures of 'coopetition' between different functional specialists (Hill et al. 1992; Luo et al. 2006; Tsai 2002). While intra-firm cooperation has to occur for working towards overarching organizational goals, intra-firm competition results from direct comparisons between functions, limited tangible and intangible resources, divergent secondary goals and strategic priorities. When competition takes the overhand suspicion may replace trust and consequently knowledge sharing and integration may be sacrificed because of lack of collaboration. Clear and transparent interrelated reward criteria and incentive systems can reduce this mistrust among functional specialists and strengthen ties (Griffin and Hauser 1996). Within inter-firm relationships, ties can be strengthened by developing a 'shadow of the future' (Parkhe 1993). A shadow of the future refers to the bond between anticipated future benefits of collaboration and present interactions between firms. Collaborative performance is better promoted the longer the shadow of the future, or the thicker the nexus between current moves and future consequences, since the forward-looking expectations diminish the tendency towards the violation of current agreements. Shadows of the future can be lengthened by long term collaborative goals, frequent partner interactions, and high behavioral transparency.

Boundary objects are key elements of knowledge representation that can provide for shared language and narratives to facilitate both knowledge generation and integration (Carlile 2002; Im and Rai 2008; Star 1989). The creation and management of boundary objects is a key process in developing and maintaining representation schemes across different actors. Examples in product development are prototypes, formalized models and shared processes. Common knowledge brought forward by these objects is used to negotiate and transform knowledge and resolve different interests among actors.

2.2.3 Organizational learning and product innovation

Although we have discussed some work on organizational knowledge that stresses knowledge dynamics, the *organizational learning* perspective primarily emphasizes the processes trough which knowledge changes or flows (Vera and Crossan 2003). In this research I follow the cognitive perspective on organizational learning (Chiva and Alegre 2005) which fits the cognitive possession perspective on organizational knowledge that was taken earlier. In agreeing with a growing group of theorists who emphasize the relationship between cognition and behavior it is argued that a learning process encompasses change on both aspects (Argyris and Schön 1978; Duncan and Weiss 1979; Fiol

and Lyles 1985; Huber 1991)[3]. Individuals and groups seem to learn by understanding and then acting or vice-versa (Crossan et al. 1999).

Because of their intrinsic notion of change, organizational learning approaches have been associated with questions of how organizations evolve and transform (Barnett et al. 1994), renew themselves (Crossan et al. 1999; Henderson and Cockburn 1994; Leonard-Barton 1992), and perform product innovation (Lynn et al. 1999; McKee 1992; Michael and Palandjian 2004; Moorman 1995).

The cognitive perspective on organizational learning: two approaches

The cognitive perspective on organizational learning roughly consists of two approaches (Chiva and Alegre 2005; Cook and Yanow 1996). The first approach focuses on individual learning *as a model* for organizational learning. Thus, learning in organizations is based on human learning processes (Cyert and March 1963; Daft and Weick 1984; Hedberg 1981; Levitt and March 1988). This approach assumes that organizations are able to learn because they have similar or comparable capacities to those of individuals. Organizational learning is regarded as being more than the sum of the learning of its members. As was argued by Hedberg (1981: 6). 'Although organizational learning occurs through individuals, it would be a mistake to conclude that organizational learning is nothing but the cumulative results of their members' learning ….. members come and go, and leadership changes, but organizational memories preserve certain behaviors, mental maps, norms and values over time'. The second approach understands organizational learning as *individual learning* in organizational context (Dodgson 1993; March and Olson 1975; Shrivastava 1983; Simon 1991). Theorists following this approach consider organizational learning as being a type of individual learning carried out in organizations by key individuals whose learning is linked to possible organizational change. As Simon (1991: 176) argued: 'All learning takes place inside individual human heads; an organization learns in only two ways: a) by the learning of its members; or b) by ingesting new members who have knowledge the organization did not previously have'. Most authors, however, follow the first approach and perceive organizational learning to be somewhat more than the sum of individual learning of organizational members, although the role of individuals and their learning is also taken into account (Huysman 1999; Vera and Crossan 2003). By acknowledging the existence of non-human repositories of knowledge and organizational learning systems that allow firms to learn, to know, and to have a memory, this first approach is also adopted in this research. When individual and group learning becomes institutionalized, organizational learning occurs and knowledge is embedded in non-human repositories such as routines, systems, structures, culture and strategy (Crossan et al. 1999; Nelson and Winter 1982; Walsh and Ungson 1991).

Organizational learning and performance: the importance of learning strategy

Researchers carry opposite viewpoints on the impact of learning on performance. One side of the discussion is represented by scholars that emphasize a positive link between these constructs arguing

[3] Additionally, it is recognized that there can be a time gap between these two types of change (Menon and Varadarajan 1992; Sitkin et al. 1998).

that improved performance is learning (Cangalosi and Dill 1965; Fiol and Lyles 1985). On the other side, authors stress that the direct link between organizational learning and performance is not that obvious. As Miner and Mezias (1996) argue: 'although learning carries a positive connotation in many cultures, research on organizational learning clearly shows it may or may not produce good outcomes'. Additionally, Levitt and March (1988: 335) argue that 'learning does not always lead to intelligent behavior', while Huber (1991: 89) adds that 'learning does not always increase the learner's effectiveness, or even potential effectiveness …. entities can incorrectly learn, and they can correctly learn that what is incorrect'. Finally, by reviewing the organizational learning literature, Crossan and colleagues (1999) conclude that good performance is not a sign of learning and that learning may negatively impact performance. This research joins this latter group. It is claimed that the effectiveness of learning can only be assessed if contextual, and in particular strategic, variables are included. Only when the organizational learning strategy matches the organizational strategy the impact of learning can be positive (Vera and Crossan 2003). If this match is not achieved, learning may have no impact or even a negative impact on performance. Recently, researchers have started to develop learning or knowledge strategy constructs. Bierly and Chakrabarti (1996), for instance, define a knowledge strategy as the set of strategic choices that shape and direct organizational learning processes and determine the firm's knowledge base. Another definition comes from Zack (1999) who suggests that a knowledge strategy describes the overall approach an organization intends to take to align its knowledge resources and capabilities to the intellectual requirements of its business strategy. Through a knowledge strategy, organizations identify the knowledge required to execute their strategic intent, compare that to the existing knowledge base and recognize knowledge gaps and opportunities for learning. A common challenge in developing and implementing a learning strategy is combining exploration and exploitation (Argote 1999; Bierly and Chakrabarti 1996; March 1991; Zack 1999).

Combining exploration and exploitation in organizational learning

Some of the earliest theoretical contributions relevant to exploration and exploitation can be found in the work of Cyert and March (1963). These authors posit problematic search and slack search as drivers of organizational change in general and innovation in particular (Greve 2007). This work addresses the fundamental assertion in strategic management and organizational theory that successful organizations and other adaptive systems balance conflicting demands of today's operations while preparing for tomorrows opportunities and challenges[4]. Over the last two decades March's (1991) seminal discourse on combining exploration and exploitation in organizational learning has caught the imagination of researchers in framing theoretical propositions and guiding empirical research. Next to organizational learning, March's approach has been applied to product innovation, organizational design, organizational adaptation, and strategy making and implementation (Gupta et al. 2006; Raisch and Birkinshaw 2008).

[4] Similar ideas have pervaded in other classical works such as Penrose's (1959) 'growth trajectories' and Thompson's (1967) 'paradox of administration'.

March (1991) proposes that all activity includes at least some learning. Even when an organization attempts to do nothing more than replicate past actions it accumulates experience and moves down the learning curve, albeit in an incremental manner (Yelle 1979). For adaptive systems there is no such thing as perfect replication. Thus, there is always some learning even if this is very little and serves only to reduce variation around a historical mean. Additionally, March proposes that organizational learning consists of exploration and exploitation, which are two fundamentally different learning activities, between which organizations have to divide their time and resources. Whereas exploration refers to notions such as variation, search, and experimentation, exploitation is associated with activities such as updating, refinement, choice, and implementation (Gupta et al. 2006; March 1991). Combining these two activities represents a tension between old and new. It embodies a struggle between the comfort of the past and the uncertainty of the future. While exploration results in variation, exploitation benefits the selection and retention stages of the learning cycle (Zollo and Winter 2002). Exploration and exploitation may therefore require fundamentally different strategies, mental models, systems, and practices (Crossan et al. 1999; March 1991). As such, organizational learning often presents a paradox: the simultaneous presence of contradictory elements (Lewis 2000; Poole and Van de Ven 1989; Quinn and Cameron 1988). March's twin concepts reflect other classifications of different modes of learning such as double loop versus single loop learning (Argyris and Schön 1978), generative versus adaptive learning (Senge 1990), long jump versus local search (Levinthal 1997), and radical versus incremental learning (Miner and Mezias 1996).

Following March's (1991) observation of the inherent tension between the two activities, some strategy scholars suggest that firms should choose one learning mode over the other (Barney 1991; Miller and Friesen 1986; Porter 1980). It is argued that organizations that pursue both activities are sacrificing internal consistency, which will lead to inferior overall performance if compared to more focused firms. These arguments are, however, contrary to March's belief that organizations have to pursue both types of learning despite the challenges involved. He argues that problems and tensions will invariably arise if organizations focus on one of these at the expense of the other. Embracing learning paradoxes and tap their potential for organizational renewal becomes specifically relevant in today's organizational environments. As competition intensifies and the pace of change accelerates, combining exploration and exploitation becomes a crucial capability for survival (Brown and Eisenhardt 1997). In the industry for mobile phone devices, for instance, firms should explore new technologies and markets (i.e. exploration) and at the same time refine their operational processes to keep costs at an increasingly lower level (i.e. exploitation). This view has led to the proposition that organizations capable of pursuing both exploration and exploitation are, eventually, more likely to achieve superior performance than organizations emphasizing one at the expense of the other (Tushman and O'Reilly 1996). Researchers of organization have pointed out traps that firms can fall into if they, consciously or unconsciously, ignore this learning paradox (Levinthal and March 1993; Miller 1992).

Organizations that principally pursue exploration run a risk because their returns are difficult to estimate a priori and may take a long term to materialize, if at all. As Levinthal and March (1993: 105)

argue, these firms run the risk of falling into the *failure trap* in which they turn 'into frenzies of experimentation ….. by a dynamic of failure'. These entities will ordinarily suffer from the fact that they will never gain the returns of their knowledge. Failure to exploit new knowledge leads to search for new knowledge which leads to failure to exploit and so on. In contrast, organizations that will only go for exploitation usually will receive returns that are proximate and predictable but not necessary sustainable. These organizations run the risk of falling into the *success trap* where they discover the 'short term virtue of local refinement and the folly of exploration' (Levinthal and March 1993: 105). As continuous exploitation causes greater and greater competence in a particular activity, they engage in that activity more, thus further increasing competence and the opportunity costs of exploration. This narrow search may lead to increasingly rigid cognitive maps, strategies, routines and practices and highly specialized competences that may become core rigidities (Leonard-Barton 1992) or core incompetences (Dougherty 1995). An excessive focus on exploitation may enhance short-term performance but can result in a capability trap as organizations may not be able to respond adequately to environmental changes (Ahuja and Lampert 2001; Levitt and March 1988)[5].

Exploration and exploitation and performance

Despite the rapidly expanding number of studies referring to combining exploration and exploitation, eventually, leading to higher performance, empirical tests and evidence have just started to emerge (Uotila et al. 2009). He and Wong (2004) were among the first who tested the 'combining hypothesis'. Based on data from 204 Asian manufacturing firms and in the context of technological innovation strategies they found evidence that the interaction between simultaneous exploration and exploitation is positively related to sales growth rate while the relative imbalance between the twin concepts is negatively related to sales growth rate. Additionally, Gibson and Birkinshaw (2004), based on data from 4,195 individuals in 41 business units, found evidence that a business unit's capacity to simultaneously achieve high levels of exploration and exploitation was significantly related to its higher performance. Lubatkin and colleagues (2006) tested the effect of combining exploration and exploitation on firm performance by using a dataset of 139 small and medium-sized enterprises. These authors found that combining an exploitative and exploratory orientation positively affects performance. A study by Uotila and colleagues (2009) investigated the trade-off between exploration and exploitation and tested its effect on firm market value. Based on data from 279 *S&P 500* manufacturing firms spanning the years 1989 – 2004, these authors found an inverted U-shaped relationship between the relative share of exploration and firm market value. Additionally they found that this relationship was positively moderated by the research intensity of the industry and that solely relying on exploitation benefits the market value of firms in low research intensive industries. Thus, these authors find evidence that the benefits of balancing exploration and exploitation might be contingent upon the environment an organization faces (see also Benner and Tushman 2003; Gupta et al. 2006; Jansen et al. 2006; Siggelkow and Levinthal 2003 for the

[5] If mature organizations fall into a learning trap it is more likely that they fall into the success trap than into the failure trap, because they already gain returns from their ongoing operations (Beckman 2006; Benner and Tushman 2003; 2002; Uotila et al. 2009).

moderating impact of environmental dynamism). Finally, Venkatraman et al. (2007) tested the effects of both simultaneously and sequentially combining exploration and exploitation on firm performance using data from a sample of 1,500 software firms. While simultaneously balancing exploration and exploitation did not have a significant effect on firm performance, sequentially balancing exploration and exploitation had a significant positive effect. Additionally, these authors argued that differences in firm resources might have moderated the effect of simultaneously combining the twin concepts on firm performance.

Thus, for most contemporary organizations that want to be successful in the long run, the message is to be active in both exploration and exploitation. The ability to achieve this combination has been said to lie at the heart of an organization's dynamic capabilities (Ancona et al. 2001; Eisenhardt and Martin 2000; Teece et al. 1997) and has caused a significant number of organizational researchers to shift from trade-off to paradoxical thinking (Gavetti and Levinthal 2000; Lewis 2000; Poole and Van de Ven 1989; Prud'homme van Reine and Dankbaar 2009; Quinn and Cameron 1988).

Exploration and exploitation in the context of really new product innovation

Because product innovation is considered as a critical strategic option for firm growth and adaptation, its successful implementation demonstrates a firm's capability of effective organizational learning (von Hippel 1994). As such, it is no surprise that exploration and exploitation are profoundly used in the context of product innovation. However, haziness in terminology remains (Gupta et al. 2006; Raisch and Birkinshaw 2008).

Some of this ambiguity results from researchers using different levels of analysis. Most work on the twin concepts in the context of product innovation has focused on the product innovation portfolio level (Li et al. 2008b; Raisch and Birkinshaw 2008)[6]. From this perspective, exploitation is attributed to refining current products for current markets, or incremental product innovation, while exploration points to experimenting with new ideas, or really new product innovation (Benner and Tushman 2002; He and Wong 2004; Jansen et al. 2006). However, another possibility is taking a more detailed perspective and attributing exploitation and exploration to changes in the knowledge resources that underpin new products (Cheng and Van de Ven 1996; Danneels 2002; Katila and Ahuja 2002; McGrath 2001). In the latter case, exploitation refers to updating existing firm knowledge resources and using this knowledge in product innovation, while exploration is about generating new knowledge and its usage in innovation activities.

For incremental product innovation, the difference in perspective yields limited interpretation problems: the refinement of current products for current markets is solely based on updating existing knowledge resources and using them in product innovation activities. In contrast, different viewpoints may lead to ambiguity in the case of really new product innovation. While some may see this set of activities as pure exploration, others might argue that the process is based on combining

[6] Li et al. (2008b) also identify studies that attribute exploration and exploitation in the context of product innovation to less detailed levels of analysis such as the corporate group level and the industry level. However, from their literature review it appears that these studies only represent a fraction of the total number of papers on the topic.

exploitation and exploration in underlying knowledge resources. From a more detailed perspective, instead of solely building on new knowledge, the majority of really new product ideas combine knowledge resources that already reside in the firm with knowledge that is newly generated (Danneels 2002; Kyriakopoulos and Moorman 2004). In these cases, existing knowledge provides the necessary absorptive capacity to use new knowledge, and ideas are a synthesis between a problem and its solution where neither the problem nor solution is new in itself (Kogut and Zander 1992; Luo 2002). Thus, a detailed perspective permits a more granular view which opens up the possibility to study variation at the subsystem level. Within the context of really new product innovation the exploration/exploitation combination may vary. Some components might be the result of exploration while others might be produced by exploitation (Gatignon et al. 2002). BMW's new Rolls-Royce Phantom model, for instance, used elements that were taken from BMW's existing 7-series vehicles (exploitation) and components that were completely new to the firm (exploration) (Raisch and Birkinshaw 2008: 401).

2.2.4 Combining exploration and exploitation in organizational learning

Although various scholars have stressed the importance of combining exploration and exploitation in organizational learning, the question how firms actually resolve this learning paradox has gained much less attention (Raisch and Birkinshaw 2008).

As was discussed before, firms can accept the tension between exploration and exploitation, choose one learning mode over the other, and align their organization to the mode of choice. In this case, the firm develops an organizational configuration based on internally consistent elements. For instance, it is well known that mechanistic configurations, which rely on standardization, centralization, and formalization, support exploitation but hinder exploration. In contrast, organic organizations, which have high levels of decentralization and autonomy, fit innovative activities such as exploration but are less suited for exploitation (Burns and Stalker 1961). Another possibility to accept the learning paradox has been to externalize either exploration or exploitation through outsourcing or establishing alliances (Holmqvist 2004; Lavie and Rosenkopf 2006; Rothaermel and Deeds 2004). For example, a significant part of really new product development in the pharmaceutical industry happens through collaborations between small biotech firms that focus on exploration and 'Big Pharma' addressing exploitation.

Next to accepting the learning paradox, firms may develop *ambidextrous* organizations that resolve the tension between exploration and exploitation and tap their potential for organizational renewal. In general, organizational ambidexterity refers to the organization being able to do two different things at the same time (Gibson and Birkinshaw 2004). The term was introduced by Duncan (1976) who used it to describe organizations that were able to design dual architectures that facilitated both the initiation and the implementation phases of the innovation process[7]. More recently, Tushman and O'Reilly (1996) described ambidextrous organizations as complex

[7] Although Duncan (1976) was the first to use the term, according to Raisch and Birkinshaw (2008) it was March's (1991) article on exploration and exploitation that acted as catalyst for the current interest in the topic.

organizational forms composed of mechanistic and organic elements that are collectively capable of operating simultaneously for exploration and exploitation. Given the paradoxical nature of combining and synchronizing exploration and exploitation, it should be noticed that developing ambidextrous organizations is a complex task. In general, literature describes two ways of how organizations may become ambidextrous and resolve the organizational learning paradox. These different approaches can be identified by their difference in organizational structure and senior management roles (Raisch and Birkinshaw 2008).

One group of studies has emphasized structural differentiation, which refers to the subdivision of exploration and exploitation into distinct organizational units each with a suitable organizational context for one learning task. In this approach, exploitation takes place in the mainstream organization that is responsible for the running business and has a mechanistic organizational configuration, while exploration should happen in smaller, more decentralized and flexible units that focus on new directions (Benner and Tushman 2002; Christensen 1997; Tushman and O'Reilly 1996). However, because exploration and exploitation have to be combined to create long-term value, the coexistence of exploration and exploitation in different units is an important yet insufficient condition for organizational ambidexterity. Therefore, several researchers have pointed to the importance of combining structural differentiation with senior management integration across differentiated units (Benner and Tushman 2003; O'Reilly and Tushman 2008; Smith and Tushman 2005; Tushman and O'Reilly 1996). Senior managers should develop an overarching and compelling strategic intent and have a large stake in explicitly integrating exploration and exploitation. Although it is acknowledged that integration at high organizational levels is important, some recently emerged research has advocated lower level integration mechanisms between the two units as well. Based on data from a detailed case study in a fashion company Tran (2008), for instance, illustrates that the organization used several processes and organizational routines to integrate and coordinate the overall development of synergies between their main collection (exploitation) and their catch-up collections (exploration). Similarly, Jansen and colleagues (2009) found that besides top management integration also lateral organizational interfaces between exploration and exploitation units can contribute to the effectiveness of pursuing the twin concepts simultaneously.

A second group of studies has focused on structural integration and emphasized behavioral mechanisms that allow organizations to pursue exploration and exploitation within the same unit (Adler and Borys 1996; Adler et al. 1999; Ghoshal and Bartlett 1994; Gibson and Birkinshaw 2004; McDonough and Leifer 1983; Sheremata 2000). Because in these organizations the majority of organizational members rely on the same basic experiences, values and capabilities to carry out both learning tasks, there is a certain risk that they fall into the success trap, in which exploitation drives out exploration (Inkpen and Tsang 2005; Levinthal and March 1993). To lower this risk, scholars have proposed that single organizations should develop multiple structures. In these cases, the integrated organizational context should be complemented by 'tactical' differentiation practices such as, setting up project teams, quality circles, and job enrichment schemes, which enable organizational members to make choices and move back and forth between a more bureaucratic structure for exploitation and a more organic structure for exploration. Again senior management has an important role. As

key leaders in organizations they should put in place strategies and systems that shape the exploration and exploitation behavior of organizational members acting on a lower hierarchical level (Ghoshal and Bartlett 1994; Smith 2006) or play a more catalytic role, in which they promote ambidextrous ideas that emerge bottom up (Floyd and Lane 2000; Gibson and Birkinshaw 2004).

Because neither differentiation with tactical integration nor integration with tactical differentiation may allow for maximizing both exploration and exploitation, an organizational designer's task is to determine the right degree of differentiation and integration in organizational structure. It is speculated that the right degree depends on the relative importance of exploration and exploitation in organizational tasks (Raisch et al. 2009). Additionally, most literature on organizational ambidexterity has taken a static viewpoint and recommends fixed positions (e.g. Tushman and O'Reilly 1996). However, modern contingency theory has brought to light that alignment between exploration and exploitation is often a dynamic process rather than something that ends in a steady state. Organizations frequently need to reconfigure to adapt to changing internal and external contingencies (Short et al. 2008; Siggelkow 2002). Cheng and Van de Ven (1996), for instance, found that the initiation phase of product innovation was characterized by high levels of exploration while the implementation phase showed increasing levels of exploitation (see also Zaltman et al. 1973). Although some literature on organizational ambidexterity has taken a dynamic perspective, it remains unclear how small differentiated units that are designed for exploration evolve over time. Several studies point to the benefits of temporary decentralization in which mainstream organizations use differentiated units for exploration and then reintegrate them in later phases of the innovation life cycle when exploitation becomes more dominant (Siggelkow and Levinthal 2003; Westerman et al. 2006). In contrast, a second group of studies has shown that differentiated units can remain differentiated from the mainstream organization for long periods of time despite increasing levels of exploitation. For example, Raisch (2008) showed that the premium coffee maker Nespresso started out as a rather autonomous unit within the Nestlé Group and maintained this position for over two decades even though the level of exploitation in activities increased.

2.2.5 Summary

This second section discussed really new product innovation from a knowledge management perspective. It defined knowledge attributes and addressed that knowledge (approached from a cognitive possession perspective) and its dynamics are important for really new product innovation and firm competitive advantage. Knowledge generation from the external environment and its integration with other relevant product innovation knowledge resources were identified as major knowledge flows in really new product innovation. Based on different social capital dimensions (structural, relational, and cognitive) of a focal actor (functional department) we have proposed specific conditions for facilitating knowledge flows. This section also shed light on knowledge dynamics from the perspective of organizational learning, which allows for linking knowledge dynamics to firm level strategies. Specific attention was given to exploration and exploitation in organizational learning and the importance of combining these twin concepts for firm survival. This

section concluded with discussing different perspectives on the meaning of exploration and exploitation in the context of product innovation and identifying different organizational approaches for combining exploration and exploitation in organizational learning within the firm.

Extending the theoretical perspective of 'product innovation as information processing' with work on creating and integrating knowledge and organizational learning allowed for developing a more detailed perspective on really new product development projects. However, we think that complementing the two research streams with work from the field of marketing can bring another perspective to the table and convey relevant insights that, until now, had limited consideration.

2.3 A marketing perspective on product innovation

Overall, the marketing literature is well positioned to participate in the initial understanding of how firms resolve the market learning paradox in the course of really new product innovation projects. A necessary component of product innovation performance is product effectiveness which depends on satisfying customer needs better (or more efficiently) than competitors (Brown and Eisenhardt 1995). Research in marketing is intrinsically customer- and competitor-focused and thus highly relevant when studying how a firm learns from the market during product innovation (Dahan and Hauser 2002; Hauser et al. 2006; Verhoef and Leeflang 2009). To complement the theoretical perspectives in our research, this section will discuss the specifics of interacting with the market environment in product innovation and the management of this process. More specifically, we will present contributions of the literature on market orientation and market oriented product innovation. This section will be concluded by a summary.

2.3.1 Introducing market orientation

During the 1950s and 1960s, marketing thought was moving from the world of mere techniques to the broader field of management (Webster 2002). A rising number of scholars argued that customer satisfaction should be the guiding principle of firms and the ultimate aim of organizational activities. Peter Drucker (1959: 37), for instance, asserted that the only valid definition of business purpose is to create a satisfied customer'[8]. This perspective has traditionally been associated with the term *marketing concept* which 'maintains that all areas of the firm should be customer oriented, all marketing activities should be integrated, and profit, not just sales, should be the objective' (Hunt and Morgan 1995: 11). It took until the 1990s before the analytical work on implementing the marketing concept was performed (Lafferty and Hult 2001). This happened under the flag of *market orientation*. The relevance of market orientation in the marketing literature is clearly demonstrated by the market orientation construct totally superseding that of the marketing concept in the academic debate of the 1990s. As Hunt and Lambe (2000: 25) put it: 'If there were any contributions that marketing could make to business strategy that might be considered universally to be uniquely marketing, it would be that of market orientation'. Initially two perspectives on market orientation emerged which, to some extent, can be considered as opposite viewpoints (Day 1994a; Homburg and

[8] For additional work from this period see also Levitt (1960), Kotler (1967), and McNamara (1972).

Pflesser 2000; Hunt and Morgan 1996; Jaworski and Kohli 1996; Lafferty and Hult 2001). The first perspective is centered on behavior, while the second perspective has a cultural viewpoint.

The behaviorists see market orientation as a set of information processing activities. Although a number of scholars take this perspective[9], most of these studies are based on the foundations built by Kohli and Jaworski (1990), incorporating measures in Kohli, Jaworski, and Kumar (1993), and Ruekert (1992). Through an analysis of previous literature and a series of interviews with marketing and non-marketing managers in a wide variety of industries, these authors defined market orientation as: 'The organization-wide generation of market intelligence pertaining to current and future customer needs, dissemination of the intelligence across departments, and organization-wide responsiveness to it' (Kohli and Jaworski 1990: 6). The behaviorists highlight the information content that denotes market orientation. A firm can consider itself more or less market oriented depending on the ability to process market information. Kohli and Jaworski (1990) conceptualized market information as a broad concept going beyond the verbalized needs and preferences of customers. They included monitoring competitors' actions and their effect on customer preferences, as well as other exogenous factors such as government regulations, and technology and environmental forces. The responsiveness to market information can take the form of selecting the appropriate target markets, and designing, producing, promoting and distributing products that meet current and anticipated customer needs.

The other widely adopted perspective is the cultural view[10], which regards market orientation as a business philosophy embedded in the firm's culture. Its foundations were built by Narver and Slater (1990). These authors (1990: 21) saw market orientation as 'the organizational culture that most effectively and efficiently creates the necessary behaviors for the creation of superior value for buyers and, thus, continuous superior performance for the business.' Although Narver and Slater defined market orientation as organizational culture, they put it into operation with three behavioral components: customer orientation, competitor orientation, and interdepartmental coordination. Thus it appears that organizational culture represents market orientation itself, while market information processing is its behavioral consequence. In contrast with Kohli and Jaworkski (1990), these authors place a greater emphasis on competitor information.

While there are pros and cons to both the behavioral and the cultural view of market orientation with respect to conceptualization and measurement (Oczkowski and Farrell 1998), and there is a debate on the value of each perspective (Jaworski and Kohli 1996; Lafferty and Hult 2001), both conceptualizations share certain similarities. First, information on customer needs and wants is central to market orientation. Second, both balance an internal and external organizational perspective. Third, there is an explicit sentiment that the whole firm should respond to identified customer needs. Fourth, the scope of market orientation goes beyond customers and incorporates competitors and the forces shaping customer needs such as technology, regulations and the like.

[9] See for an overview of studies, for instance, Lafferty and Hult (2001)

[10] A critical contribution to the conception and modeling of market orientation as organizational culture can be found in Harris and Ogbonna (1999).

Market orientation and related concepts

The market orientation stream of literature has some overlap with several other theoretical concepts (Jaworski and Kohli 1996; Morgan 2003) of which two important ones have already been discussed in earlier sections: organizational learning and dynamic capabilities. In the remainder of this section related concepts are compared and contrasted with the market orientation construct with the purpose to elaborate on their relationship.

The marketing literature is characteristic in detecting elements in cognate disciplines and introducing them within the perspective of mainstream marketing (Zinkhan 1999). As a consequence, organizational learning has been touched upon by several marketing scholars. It can be argued that the description of organizational learning presents similarities with the concept of market orientation. They both help to explain the critical organizational capability of market sensing, are concerned with organizational wide phenomena such as culture and norms, and encompass relationships and interdependencies between individuals and groups and the coordinated use of both tangible and intangible resources (Bell et al. 2002: 79). The marketing field proposes that for a firm to sustain competitive advantage it has to learn faster on how to create superior customer value than its competitors (Day 1994a; 1994b). Research has suggested (Slater and Narver 1995) and empirically verified (Baker and Sinkula 1999a; 1999b; Sinkula et al. 1997) a complementary role of the construct 'learning orientation', next to a market orientation, to support market information processing. Additionally, Sinkula (1994) discussed market information processing as market-based organizational learning consisting of the acquisition, distribution, interpretation and storage of market information. Sinkula's approach offers several insights which enrich market orientation thought (Jaworski and Kohli, 1996). First, the market orientation perspective implicitly suggests that market information is interpreted by the person(s) acquiring this information prior to disseminating it. In contrast, Sinkula's approach suggests that interpretation may also occur after the information is shared with others. Second, his approach is more explicit on memory (i.e. storage) shaping the nature of acquisition and dissemination within organizations. Third, where market orientation tends to focus on information generation from external sources, Sinkula's approach suggests that market information may also be generated from internal sources such as company databases.

Marketing scholars have also combined the dynamic capabilities approach with market orientation. In an influential work, Day (1994a: 38) defines capabilities as 'complex bundles of skills and accumulated knowledge, exercised through organizational processes, that enable firms to coordinate activities and make use of their assets'. He classifies capabilities depending on the focus of the processes into *inside-out capabilities*, *outside-in capabilities* and *spanning capabilities*. Inside out capabilities form one end of the spectrum and have an internal focus. They are deployed from the inside out and activated by market requirements, competitive challenges, and external opportunities. Examples are 'manufacturing' and 'technology development'. At the other end of the spectrum are outside-in capabilities whose focal point is almost exclusively outside the organization. The purpose of these outside-in capabilities is to connect the other capabilities to the external environment, enabling the business to compete by anticipating market requirements and creating durable relationships. Finally, spanning capabilities are needed to integrate both inside-out and

outside-in capabilities. For example, product innovation, which is a spanning capability in Day's terms, must be informed both from external and internal analyses. Day argues that market driven organizations are specifically superior in two outside-in capabilities: market sensing and customer linking. While a market sensing capability is, in essence, comparable with market orientation, the author complements it with a customer linking capability. This capability can be defined as the capability to create and manage close customer and channel member relationships. A similar addition is made by Srivastava et al. (2001) who link the resource based view and capabilities thinking to marketing. Next to a firm's intellectual market based assets, which are developed through market information processing activities, these authors identify relational market based assets. These assets are built through developing close relations with customers to the point that they may be relatively rare and difficult to replicate by competitors. From a market information perspective, including this relational perspective adds another relevant customer information dimension. Besides information on customer needs and wants one can also conceptualize customer contact information (Zahay et al. 2004).

In sum, it can be argued that insights from organizational learning and dynamic capabilities have enriched the market orientation construct. The adoption of organizational learning has focused the attention to the importance of cognitive elements such information interpretation and organizational memory in market information processing. Insights from the field of dynamic capabilities have put the spotlight on the importance of customer relationships and customer linking capabilities, next to market information processing, for market orientation and firm performance.

2.3.2 Market oriented product development

Until the mid-90s, market orientation models did not explain why an organization that systematically generates, disseminates and utilizes market information is able to attain better performance than a firm that does not undertake such activities. The question is: in what way can adopting a market orientation enable an organization to attain competitive advantage? One of the answers is *better product innovation*. The rationale is that a market oriented culture and the associated information processing behaviors reduce risk associated with performing product development. Specifically from the mid-90s onwards, many studies link market orientation, or closely related conceptualizations, to product development activities and/or product innovation performance (Atuahene-Gima 1995; Atuahene-Gima et al. 2005; Baker and Sinkula 2007; Gatignon and Xuereb 1997; Kyriakopoulos and Moorman 2004; Li and Calantone 1998; Moorman 1995; Narver et al. 2004; Ottum and Moore 1997; Veldhuizen et al. 2006). Additionally, studies have analyzed the mediating power of product innovation in the market orientation - performance relationship (Baker and Sinkula 1999a; Han et al. 1998; Langerak et al. 2004; Zhou et al. 2005). A meta-analysis performed by Kirca et al. (2005), which included 114 studies, empirically verified that a market orientation, generally, has a positive influence on organizational performance via the organizational capability of product development[11].

[11] Organizational performance was measured by cost-based performance indicators, which reflect performance after accounting for the costs of implementing a strategy (e.g. profit measures), revenue-based performance

Deeper analyses revealed that a market orientation positively influences the creation of new products, and that new products enable the organization to meet the evolving needs of customers, thus influencing customer loyalty and the perceived quality of a firm's products. In turn, the elements of customer loyalty and perceived quality positively influence organizational performance.

Furthermore, findings from the product innovation literature report the importance of a market perspective for product development effectiveness as well. Already in the late 1970s, Cooper (1979) concluded that a strong market orientation was one of the controllable factors that contributed to new product success. Several important product development studies echo these findings. In their meta-analysis, Montoya-Weiss and Calantone (1994) conclude that the proficiency of marketing activities during the product development process has a strong positive effect on new product advantage. In a similar vein, the literature review of Brown and Eisenhardt (1995) argues that a significant number of studies highlight the importance of customer involvement for the effectiveness of product concepts and better product designs. According to Cooper (2001), a failure to build in the voice of the customer, a poor competitor analysis, and limited understanding of market trends are common weaknesses found in many studies on new product failures. Contrary to general expectations, a market orientation may also improve product development efficiency (Burchill and Fine 1997; Cooper and Kleinschmidt 1994b). For example, based on an analysis of data from 103 product development projects from the chemical industry, Cooper and Kleinschmidt (1994) found that including a customer viewpoint into the new product process did not increase but actually reduced product development cycle time.

Market orientation and really new product innovation

While a market orientation generally is regarded as positive in the context of product innovation, there has also been criticism. Already in the 1970s and 1980s, Tauber (1974), Bennet and Cooper (1979; 1981), and Hayes and Abernathy (1980) claimed that the excessive focus of firms on expressed customers needs reduced their capacity to generate really new products, which are based on satisfying latent customer needs. It was argued that being market oriented locks the firm into its current customer base, thereby causing the firm to miss out on the wave of new technologies and emerging customer needs (Hamel and Prahalad, 1994). A decade later, following the same line of reasoning, Christensen and Bower (1996) opened this debate once again with their longitudinal study on the disk drive industry. These authors showed how leading firms in the technology that dominated the industry at a certain point in time, systematically lost their leadership when new technology came about. The authors argued that this happened because too much emphasis was placed on customers' expressed needs in allocating investments for product innovation. On the contrary, winning companies took risks and invested resources in more innovative projects that did not seem to have great market potential at start but proved to be products that later dominated the market. The losing companies listened too carefully to their customers that simply were not aware of

indicators (e.g. sales and market share), and manager's perceptions of overall business performance (e.g. comparisons of organizational performance with company objectives and/or competitors' performance).

new technological developments and therefore did not express a need for them. Christensen (1997) subsequently examined a variety of other industries and identified the same pattern. Additionally, similar ideas have been put forward by other researchers (Berthon et al. 1999; Frosch 1996; MacDonald 1995b).

Specifically Christensen and Bower's article gave rise to a series of comments in *Strategic Management Journal* articulating different positions in the debate on the effects of market orientation on product innovation performance. Slater and Narver (1998) draw a distinction between customer orientation and market orientation. Firms that adopt the former emphasize customer expressed needs while firms emphasizing the latter develop long term thinking, a desire to satisfy existing customers' latent needs and search for new customers and market opportunities. (see also Connor 1999; Ketchen et al. 2007; Slater and Narver 1999). In the context of this debate, Danneels (2003) analyzed the paradox of tight linkages with customers and their benefits for product innovation performance. By borrowing the notion of tight and loose coupling (Orton and Weick 1990) he illustrated how firms forged tight customer links, in which cognitions and actions reinforced each other, and became increasingly focused on them. However, this tight coupling came at a price of increased commitment and restricted vision. Therefore he argued that firms should put effort in balancing the natural process of tight coupling with a deliberate process of loose coupling. In a subsequent study, Danneels (2007) used a dynamic capabilities perspective and illustrated that the leverage of existing technology to address needs of customers from unserved markets required loose coupling to be complemented by a marketing capability to build new customer linkages.

Market orientation, alternative perspectives, and really new product development

Although important market orientation scholars agree that market oriented firms are also capable of addressing latent customer needs and leading customers during really new product development (Day 1994a; Kohli et al. 1993; Slater and Narver 1998; Slater and Narver 1999) it took some time to adopt and communicate this position. Several researchers initially emphasized that next to a market orientation, firms needed additional strategic orientations to address both expressed and latent customer needs such as an entrepreneurial orientation (Atuahene-Gima and Ko 2001; Slater and Narver 1995; Zhou et al. 2005).

Later research has argued that the debate and confusion regarding the effect of market orientation on different types of product innovation is heavily influenced by the original market orientation measurement instruments. Some scholars believe that the market orientation constructs are too narrowly put into operation to capture the effect of market orientation on lead-the-customer innovation activities. Most notably, Narver et al. (2004) argue that the concept of market orientation benefits both customer led (i.e. incremental) and lead-the-customer (i.e. really new) product development but that current measures assess market oriented behavior that is associated only to customer-led processes. In solving this problem, they re-operationalize the market orientation construct as having two elements: *responsive* market orientation and *proactive* market orientation. Responsive market orientation refers to the generation, dissemination and use of market information pertaining to current customers and product domains, focuses on expressed customer

needs, and is associated with incremental product innovation. In contrast, proactive market orientation is concerned with discovering and satisfying latent customer needs, has the potential to direct the firm to new technology, and is connected with really new product innovation[12]. Using the new measures in analyzing business unit product innovation portfolio success, Narver et al. (2004) find that a proactive market orientation is relatively more associated with innovativeness and plays an important positive role in explaining product innovation success. Using similar measures Atuahene-Gima et al. (2005) analyze both the individual relationships between each type of market orientation and their interaction effect on business unit product innovation performance. Using data from 175 U.S. business units from a wide variety of manufacturing firms, the authors find complex relationships between the two dimensions of market orientation and performance. As key result these authors find a negative interaction effect of responsive and proactive market orientation on product innovation performance. The authors argue that 'this finding, coupled with the positive correlation between the two dimensions, suggests that firms engage in both behaviors simultaneously but do not necessary derive greater benefits from a high-high combination' (Atuahene-Gima et al. 2005: 476). This implies that responsive market orientation will be more valuable to a firm's product innovation when it is matched with lower level proactive market orientation and vise-versa. Thus, while both responsive and proactive market orientations are needed, overall product innovation performance is enhanced when one is at a higher level and the other is at a lower level[13]. While this study provides insight into the specific combined effects of both market orientation dimensions on a business unit's product innovation performance, it does not inform us about the specific effect of market orientation on individual really new product innovation projects.

The effect of market orientation on really new product innovation performance

More detailed empirical evidence comes from recent studies that do not link market orientation to a firm's total product innovation portfolio but specifically focus on its impact on really new product innovation projects. Kyriakopoulus and Moorman (2004) contribute to the debate by suggesting that market orientation does not necessarily guide the firm to be reactive or proactive. It only emphasizes the focus on customers. Therefore these authors do not include marketing strategies in a firm's market orientation but separate these two elements. The authors consider *marketing exploitation* strategies that focus on the improvement of current expertise in areas such as targeting and segmenting and product distribution and *marketing exploration* strategies where current expertise is not sufficient and new knowledge and skills are needed. Based on data from 96 product innovation projects from the Dutch food processing industry, the authors find that a strong firm-level market orientation facilitates a complementarity of high levels of marketing exploration and marketing

[12] A similar dichotomy is presented by Jaworski et al. (2000).

[13] Their use of subjective product innovation portfolio success measures triggers the authors to include an alternative interpretation of this finding. They argue that a reasonable explanation of the negative effect of the interaction of responsive and proactive market orientation on product innovation performance also lies in the possibility 'that firms that have a high score on both orientations are more 'market sensitive' and therefore are likely to set very high performance goals and thus less likely to achieve them' (Atuahene-Gima et al. 2005: 476).

exploitation project strategies which results in improved new product financial success at two distinct points in time. On the contrary, firms with a weak market orientation engaging in both strategies show a significant reduction in new product financial performance. Because the majority of really new projects leverage some existing firm expertise (Nelson and Winter 1982) and therefore combine exploration and exploitation strategies, this study provides evidence that market orientation has the potential to positively influence really new product innovation as well. A study by Callahan and Lasry (2004) investigates and confirms the importance of customer input in the development of most really new products. Data were analyzed from 55 new products that are successfully introduced in the computer telephony integration industry. Based on the judgments of managers that were responsible for the introductions of the new products, the authors find that the importance of customer input for developing really new products increases with the *market newness* of the product up to a point and then drops off for a market newness that is very high. For technology newness, customer input keeps increasing with increasing *technology newness* of the product without dropping off. Furthermore, a study by Atuahene-Gima (2005) posits that a firm's market orientation is a precursor for capability building and that it effects resource allocations to focus on both exploiting existing capabilities and building new ones. It is argued that market knowledge is a resource with which managers can uncover current capability deficiencies in the firm and emerging market opportunities that may require the development of new capabilities. Based on data from 227 electronics firms from China, the author finds that a market orientation indeed has a positive influence on *exploiting* existing product innovation capabilities and *exploring* new ones. He also finds that really new product innovation performance is enhanced when capability exploration is matched with a lower level of capability exploitation and vice versa. Thus, besides a strong market orientation, successful really new product innovation seems to stem from an act of combining old and new, not necessarily from the combination of a novel technology and a novel market solution. Finally, Baker and Sinkula (2007) aimed to investigate to what extent market orientation facilitates a balanced product innovation portfolio. Based on data from 243 U.S. firms from a wide variety of industries the authors find that incremental product development is the most prioritized type of product innovation, but that a strong market orientation increases the priority placed on really new product innovation resulting in a more balanced product development portfolio. Hence, the study's results imply that a market orientation does not lead firms to over-prioritize customer-led approaches.

Summary

Based on the empirical evidence presented in this section, it appears that a market orientation does not stifle really new product innovation. Literature, in fact, presents evidence that a market orientation supports this type of innovation, specifically the kind that does not heavily diverge from markets that are familiar to the firm. The question remains how an organization can influence the generation, dissemination and utilization of market information in the context of really new product developments. In other words: 'what are the organizational antecedents of market oriented really new product innovation?'

2.3.3 Organizing for market oriented really new product development

Specifically the 'behavioral branch' of market orientation has researched the topic of organizational antecedents to the generation, dissemination and utilization of market information. Partly based on general market orientation frameworks, such as Jaworski and Kohli (1993) and Kirca et al. (2005), we will classify several organizational antecedents of market oriented really new product innovation into four broad categories: marketing function, senior management factors, market information generation methods, cross-functional integration.

Marketing function

The marketing function of the firm is uniquely positioned to perform marketing activities which are critically important to implementing many business processes within most organizations (Day 1994a; Homburg et al. 1999; Rust and Moorman 1999; Webster 2002).

An often cited problem in researching the marketing function is its lack of organizational homogeneity in structure, responsibilities and terminology (Webster 2002). Whereas standard textbooks usually present marketing as a monolithic task and function, in most organizations the marketing function is a fragmented phenomenon, rarely structured within one single function, and performed by numerous organizational departments (Krohmer et al. 2002). Following scholars such as Workman (1998), this research regards the marketing function as the organizational groups and functional specialists that connect 'the market' with other relevant functional groups in product development such as research and manufacturing. These groups often go by the names of 'marketing', 'sales', 'product management', 'strategy', 'business development', 'market research', and 'commercial development'. The marketing function connects the customer to product design by bringing an 'outside-in' perspective to the table (Day 1994a). This specific perspective is what provides the marketing function with a specialized knowledge or skill base and puts it in the center of market oriented really new product innovation (Rust and Moorman 1999; Verhoef and Leeflang 2009).

In order to structure the marketing function to maximize performance, two extreme approaches have been proposed: a functional marketing organization and a marketing process organization (Rust and Moorman 1999: 181). A functional marketing organization 'refers to the concentration of responsibility for marketing activities (knowledge and skills) within a group of specialists in the organization'. Benefits of this approach are enhanced efficiency and the ability to develop specialized distinctive knowledge and skills. The risks related to this approach, as reported by Rust and Moorman (1999), include coordination challenges between distinct functions, inter-functional conflict, functional myopia, and overspecialization. A marketing process organization 'refers to the dispersion of marketing activities (knowledge and skills) across the organization'. A marketing process organization overcomes much of the risks that are associated with a functional market organization, and several authors notice a trend of abandoning marketing as function and embracing a marketing

process organization (Nath and Mahajan 2008; Webster 1992)[14]. However, other work points to the value of specialized knowledge and skills in cross functional settings such as product innovation. Based on data from 92 product innovation projects, Moorman and Miner (1997), for example, demonstrate that higher specialized knowledge has a positive impact on product development creativity in conditions of high environmental turbulence. Additionally, Dougherty's (1990) qualitative work on market knowledge creation in product innovation suggests distinct stages that involve building unique departmental knowledge and then moving to an integrative view that cuts through departments. Looking further into this issue, Rust and Moorman (1999) propose a balanced perspective of an overall market orientation and a specialized marketing function. Based on 330 responses from managers across six business functions these authors find that a specialized marketing function contributes to product innovation performance beyond that explained by a firm's overall market orientation. This finding is extended by Verhoef and Leeflang (2009). Based on data from 296 respondents from Dutch firms these researchers find that a market orientation and a firm's marketing department simultaneously influence each other. Market oriented firms tend to have stronger marketing departments, while influential marketing departments induces a stronger market orientation.

Some researchers have specifically focused on the role of a specialized marketing function in the context of really new product innovation. Qualitative insights from twelve breakthrough innovation projects that all originated from corporate research labs of major corporations reveal that involving marketing specialists is not always a widespread believe (McDermott and O'Conner 2002; O'Connor 1998). In these studies, several teams relied on full time scientists or engineers for connecting with the market. Although these individuals were all highly respected by the other team members, they had little knowledge of marketing tasks and often had difficulties with this role. Workman´s qualitative research (1998; 1993) demonstrates that the limited role of functional marketing specialists in really new product innovation is specifically observable in high-tech firms. This author proposes and illustrates three interrelated reasons that underlie this finding: (1) The need for technical expertise to understand innovation opportunities; (2) technology oriented cultures of high-tech firms; (3) and the narrow definition of the marketing function in these firms. Although a specialized marketing function often has a limited influence in high-tech product innovation, it is argued that its involvement can increase product innovation performance. R&D specialists seem to be cognitively biased towards collecting and processing market knowledge that relates to what a product should do and what customers want, and give less attention to the number of potential customers and whether these customers value the product that much, that an idea forms a viable business opportunity (Dougherty 1990). A specialized marketing function can assist in generating complementary knowledge on the size of a market opportunity or can act as facilitator in knowledge exchange processes between research and customers. Additionally, the function can play a role in market development by bringing in complementary knowledge on (potential) partners, such as

[14] Other research, however, does not confirm this trend. For example, in their field observations, Workman et al. (1998: 35) did not find evidence that firms are eliminating marketing departments or abandoning functional organizational forms.

distributors and suppliers of complementary products, or perform market communication activities (Becker and Lillemark 2006). Finally, Veryzer (2005) undertook a mixed method study, involving a survey, field observations and in depth interviews, looking into the roles of marketing and industrial design in really new product development across a wide variety of firms. Findings from this research underwrite the positive impact of a specialized marketing function on really new product development performance.

Thus, based on the research presented above, it can be argued that the level of specialization of the marketing function in really new product development might influence the level of orientation towards the market and therefore new product performance.

Senior management factors

Senior managers play a critical role in shaping organizational values and orientations (Webster 1988). This section will focus on two closely related antecedents of market oriented really new product innovation that can be attributed to senior managers: *senior management emphasis* and *senior management willingness to take risks* (Jaworski and Kohli 1993).

General research on market orientation has indicated that senior management emphasis in communication and action on the generation, dissemination and utilization of market information has a strong influence on actual organizational market orientation. The meta-analysis of Kirca and colleagues (2005) shows the robustness of this relationship by using both bivariate and multivariate statistics. However, in the context of product innovation, senior management can over-emphasize a specific type of market orientation, which in turn effects product innovation efforts and performance differently (Atuahene-Gima 2005; Atuahene-Gima et al. 2005; Li et al. 2008a). Over-emphasizing reactive market orientation, most likely, distracts from really new product innovation, while over-emphasizing proactive market orientation does not support incremental product innovation. One of the elements by which senior management directly articulates its emphasis is the degree of strategic mission rigidity. This construct refers to the degree to which the organization's mission is defined narrowly, is inflexible, discourages activities outside the scope of current products and markets and is difficult to change (Mone et al. 1998). When a strategic mission is rigid it focuses on strategies and activities that are well suited for stable conditions but are difficult to change when new opportunities arise. A rigid strategic mission, therefore, creates a context in which innovativeness and information search in new areas is more likely to be suppressed. In contrast, when a strategic mission is more flexible, strategies and activities are more open to change and adaptation. Christensen and Bower (1996), for example, have shown that several disk drive producers could not commercialize emerging technologies that benefited new markets because their rigid strategies, which focused on existing markets and customers, did not allow for investing resources in researching new markets. In a similar vein, Tripsas and Gavetti (2000) have studied the role of senior management cognitions in the development of new competences. They show how two prevalent strategic beliefs among Polaroid Corporation's senior managers hindered the company to enter the market for digital cameras in spite of its leading-edge digital imaging capabilities. On the one hand the belief in the primacy of technology led the firm to heavily invest in research on digital imaging. On the other hand, their

strategic mission was restricted by the belief of Polaroid's senior management that their company could not make money on hardware (digital cameras) but only on consumables (film). This belief severely impeded market information gathering in this area and actual commercialization of their digital technologies.

There is some evidence that a flexible strategic mission should be complemented by the willingness of senior management to implement innovative strategies and therefore take risks. Based on responses from marketing and non-marketing managers of 222 business units that were cross-checked by 230 additional responses from American Marketing Association members, Jaworksi and Kohli (1993) have found that senior management aversion towards risk has a negative effect on market information utilization. This finding supported earlier expectations that responding to market developments entails some level of risk and that if senior managers are unwilling to assume these risks the organization is less likely to be responsive to changing customer needs. Thus, senior management willingness to take risks is closely related to a positive attitude towards change and learning (Day 1994a). However, taking risks by focusing on change enhances the possibility of failure (Levinthal and March 1993). By using two wave panel data of U.S. manufacturing firms, Danneels (2008) found that developing marketing skills to generate knowledge from new markets is enhanced when there is a certain tolerance for failure. Thus, promoting taking risks by senior management should be complemented by some tolerance for failure. Similar observations were made in the qualitative work on market learning in a wide variety of product development projects by Adams et al. (1998). These authors have shown that market information processing in really new product innovation projects was enhanced when senior management rewarded taking risks *and* did not place undue blame on failure.

In general, literature provides some evidence that market oriented really new product innovation is supported by senior management emphasis on both responsive and proactive market orientation, via the expression of a flexible strategic mission. Additionally, senior management should demonstrate some willingness to take risk which is complemented by a certain tolerance for failure.

Market information generation methods

In market oriented really new product development, a well performing marketing function links a project to the market and generates market information (Day 1994a). However, as was discussed earlier, market information can come in different dimensions (Kohli and Jaworski 1990; Narver and Slater 1990). In the context of product innovation, research, generally, distinguishes between two dimensions of market information: *segment information* and *customer need information* (Adams et al. 1998; Veldhuizen et al. 2006). Segment information refers to information on market segment size, growth rate and turbulence, and stakeholders such as competitors, distributors, and regulating groups, which can influence customer behavior. Customer need information refers to the understanding of specific customer needs and wants, which are divergences between the existing and the desired customer situation (Holt et al. 1984).

Segment information can be totally new to the firm, or an update of current understanding. Additionally, customer needs information also comes in two forms: expressed and latent (Narver et

al. 2004)[15]. Expressed needs are needs that the customer is aware of and has little difficulties in expressing, such as an existing product in a different color. In contrast, latent needs can be defined as needs of which the customer is unaware. These needs are not less 'real' than expressed needs, but they are not in the consciousness of the customer. They are not directly based on existing products and do not emerge to the conscious level until a solution is presented (Holt et al. 1984). For example, at the start of the development of computers, the needs for their benefits were latent needs.

Different types of product innovation seem to need different types of market information which require different types of market information generation methods (Deszca et al. 1999; Hamel and Prahalad 1994; Janssen and Dankbaar 2008; Leonard 1995; O'Conner and Veryzer 2001; O'Connor 1998; Veryzer 1998a; Veryzer 1998b). Thus, the type of generation methods in use, potentially, influences the course of a product innovation project. Based on the existing literature we will discuss the impact of different generation methods by using archetypes of four different product innovation project categories (figure 2.2). Besides 'continuities', all archetypes fall into the really new product innovation category.

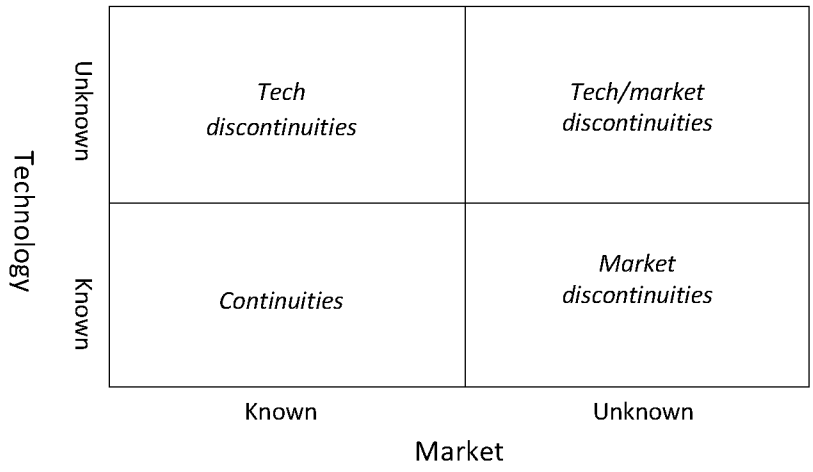


Figure 2.2: Different categories of product development projects

Continuities represent the situation of incremental product innovation. These projects focus on small updates of existing products. To initiate this type of product innovation it is proposed that developers should update their current understanding of a specific market segment. Specifically an analysis of secondary data on the immediate threats by competitors seems to have a positive effect in these projects (Atuahene-Gima 2005; Noble et al. 2002). Additionally, organizational members should collect primary data and update their knowledge on expressed customer needs (Cooper and Kleinschmidt, 1986; 1994). Because reference products already exist in the market, customers can easily recognize their own needs and express suggestions for improvements. These suggestions can be generated by using traditional market research methods such as focus groups and surveys (Leonard 1995; Slater and Narver 1998). In situations of incremental product innovation, 'learning

[15] We realize that dichotomies are often oversimplifications and rather pragmatic. However, for this overview an oversimplification is not critical.

before doing' is the norm and the large majority of the market information that is necessary for introducing a new product into the market is generated in the initiation phase of the product innovation process (Cooper and Kleinschmidt 1986; Lynn et al. 1996). In other words, there is little need for additional market information generation during actual development and commercialization.

Tech-discontinuities represent the situation of really new product innovation which highly diverges from a firm's current technology base, but is focused on known market segments. When initiating these projects, it is proposed that organizational members should update their current understanding of a specific market segment by looking further into the future. Suitable methods, which often rely on secondary data, include extrapolating trends, science and technology mapping, and scenario analyses (Leonard 1995; Schoemaker 1995; Wheelwright and Clark 1992). Furthermore, developers should generate primary data on future needs of customers. In these cases, traditional market research methods are of limited use because relationships between needs and potential solutions become obscure. Future needs are often latent because customers have limited capabilities to see through the eyes of the technologist and do not know what solutions, functions and enhanced futures a technology might offer (Leonard, 1995). Uncovering these needs requires market research methods that allow for deeper experiential interaction with customers such as the lead user approach (von Hippel 1986), emphatic design (Leonard, 1995), customer visits (Slater and Mohr 2006), and customer immersion sessions (Deszca et al. 1999). By using these methods organizational members get to know customers' working practices so well that they become able to anticipate unspoken needs. Under the 'learning by doing' logic these market research methods should be complemented by collaborating with customers to test prototypes to refine market information in the later phases of the product innovation project (Leonard 1995; Lynn et al. 1996; O'Connor 1998; Veryzer 1998a; 1998b). Since developers cannot exactly communicate the full potential of a product without a reference product, such real-life technological designs can act as powerful boundary spanning objects to gather preliminary customer feedback and modify offerings based on new insights. Testing prototypes affords the first true opportunity to 'prove out' the product idea and design in a real life setting. In testing prototypes the range of customers involved is necessary limited Because the organization cannot work intensively together with all customers it has to make choices what customers to involve (Danneels 2003).

Really new product development projects that fall into the *market-discontinuities* category are based on technology that is known to the firm but focuses on market segments that are new to the firm. To initiate these projects, it is proposed that developers should look into unserved market segments made up by totally new potential customers (Hamel en Prahalad 1994; Narver and Slater 1998). Examples are technology transfers from military to commercial applications (Danneels 2002). To develop information on the new segments, organizational members can use secondary data, such as market research reports, or visit trade fairs (Danneels 2002). Developers should also build up new contacts to generate primary data on customers needs (Leonard 1995). In these instances, potential customer needs are latent because users have a need but are incapable of imagining a solution because they are unaware of the technological potential that can be offered by the firm. Data has to

be gathered by using experiential interaction with potential customers, such as customer visits where technologies are demonstrated. Again these methods should be complemented by prototyping in the later stages for the same reasons as mentioned in *tech-discontinuities* situations.

Tech/market-discontinuities situations represent projects with a high divergence from both a firm's current technology and market base. In these projects, technological potential and market need have to coincide in both time and place for the necessary synergy to occur (Leonard 1995). Developers may try to force this coincidence by presenting totally new products to the outside world. However, this remains risky business (Leonard 1995). To initiate these projects organizational members can develop a perspective of the future by relying on general societal trends. Methods that suit this situation are comparable to the ones recommended for *tech-discontinuities* without the strong focus on specific segments. Besides anticipating the future, developers in these projects can take a more active role by trying to create the future (Deszca et al. 1999; Hamel and Prahalad 1994; O'Conner and Veryzer 2001). Methods such as 'back-casting' and 'visioning' start with an envisioned end-state and then move back to identify means to get there such as investments and activities. The key element of these approaches is a focus on 'what could be'. In *tech/market discontinuities* situations potential customer needs are latent as well. Potential customers are not able to ask for technologies that are non-existent in the marketplace. To generate customer information developers can experiment by confronting different customer groups with new technologies. Finally, prototyping is also necessary in the later stages of these projects (Leonard 1995).

This section argued that different product development projects need different market information generation methods to become market oriented projects. Without using a combination of techniques that allow for secondary data generation and techniques that can uncover latent (potential) customer needs via experimental customer interaction, it becomes much harder to successfully initiate and implement really new product innovations. It is argued that the level to which project members rely on the techniques mentioned above has an impact on market oriented really new product innovation success.

Cross-functional integration

The integration of the marketing function with other functions in the firm is widely regarded as beneficial for cross-functional activities such as product innovation. It specifically benefits the dissemination and usage of market information (De Luca and Atuahene-Gima 2007; Griffin and Hauser 1996; Kahn 1996; Kahn 2001; Kirca et al. 2005; Li and Calantone 1998; Madhavan and Grover 1998).

Cross-functional integration can be broken down into collaboration and interaction (De Luca and Atuahene-Gima 2007; Griffin and Hauser 1996; Kahn 1996). Collaboration refers to the intangible and unstructured recognition by different organizational functions of their strategic interdependence and their need to cooperate for the benefit of the organization. It ensures the alignment of goals and some degree of mutual commitment. Interaction is about organizing information integration itself. While collaboration reflects the willingness to work together, interaction points to the structural mechanisms to put this willingness into action such as meetings or other ways of information

exchange. Research on market orientation reflects the importance of these two elements. Under the label of 'interdepartmental factors' Kirca and colleagues (2005) have investigated the effects of interdepartmental conflict (i.e. lack of collaboration) and interdepartmental connectedness (i.e. interaction) on market orientation. Bivariate statistics showed that interdepartmental conflict diminished organizational market orientation, while interdepartmental connectedness enhanced it. The researchers were also able to include interdepartmental connectedness into their multivariate analyses. Findings from these analyses showed that this variable has a strong positive effect on organizational market orientation.

Despite the fact that researchers have highlighted mechanisms to improve cross-functional integration (De Luca and Atuahene-Gima 2007; Griffin and Hauser 1996; Olson et al. 1995), several organizational barriers for integrating market information across functions may exist. Well known potential barriers are cultural differences between marketing and other functions (Adams et al. 1998; De Ruyter and Wetzels 2000; Dougherty 1992; Griffin and Hauser 1996; Gupta et al. 1986; Rouziès et al. 2005; Workman 1993). Different functional backgrounds, various career paths, and diverse non-integrated institutional contexts bring about belief systems, perceptions, attitudes and competences which are idiosyncratic, and as such difficult to integrate. A well documented example are the contrasting 'thought worlds' of managers in marketing with respect to those in research (Dougherty 1992; Griffin and Hauser 1996). The former are usually oriented towards the short term, they see themselves as members of the company as a whole, focus on the market, and accept a degree of bureaucracy. The latter, instead, tend to focus on medium and long term results; share a sense of belonging that goes beyond the organizational borders to a wider scientific community, center their attention on science, and have low tolerances for bureaucracy. Naturally, these generalities do not apply to every marketing or research department, but rather indicate identifiable trends. These cultural differences can influence self-perception, relative power perception, and the sense of identity of a function, which in turn can give rise to the belief that achieving organizational goals is largely dependent on specific functional competences and behavior. One's own functional performance and processes are thought to be much more, or much less, important than those of other functions (Fisher et al. 1997; Franwick et al. 1994). These different thought worlds can limit market information integration because they create the perception that the advantages deriving from sharing knowledge are inferior to those associated with protecting it.

Turning to an information user perspective, supposing these users belong to other functional groups, two related potential barriers can be added: lack of trust in the data supplier, and a low perceived information value. Empirical evidence (Adams et al. 1998; Maltz and Kohli 1996; Maltz and Kohli 2000; Moorman and Zaltman 1993; Moorman et al. 1992) shows that trust in the data supplier influences market knowledge usage. It appears that the greater the trust of the potential user in the data source, the more the potential user will associate quality with information generated from those data. Both these variables, in turn, have a positive influence on the use of market information in decision making. The use of market knowledge also depends on the value that the information carries from a user's point of view. This value depends on the perception of accuracy of the generation methods, the ease of understanding, and the possibility to translate knowledge into

action (Maltz and Kohli 1996; Menon and Varadarajan 1992; Sinkula 1990). When these variables are perceived as low, the perceived information value, and the probability of market knowledge use, will also be low.

There is some research that looks into the differences between incremental and really new market oriented product development in relation to cross-functional integration (Atuahene-Gima 2005; Griffin and Hauser 1996; Olson et al. 1995; Souder et al. 1998; Swink 2000). The general outcome of this research is that cross-functional integration is more important in situations of really new product development than it is for situations of incremental product development. The rationale behind this finding is that when a firm and its (potential) customers are relatively unfamiliar to each other and have little previous experience with a new product concept, the functional tasks involved in developing the concept and bringing it to the market are more challenging than in situations of a more straightforward modification of an existing product. As the difficulty of product development increases, so does the interdependence of different functional specialists involved in the project. The result is a greater need for cross-functional exchanges of ideas, information and other resources. On the contrary, a small number of scholars have highlighted benefits of less integration between functional specialists in the context of really new product innovation. Moorman and Miner (1997), for instance, demonstrate that higher specialized knowledge had a positive impact on organizational product development creativity in conditions of high environmental turbulence. Furthermore, Berchicci and Tucci (2008) present a qualitative analysis of the development of a highly innovative bike-concept in which they find evidence of 'groupthink' (Janis 1982) towards new market information which had a negative effect on project performance. These latter authors argue that a development organization can work so closely together that it develops its own set of values, and adopts or rejects new information based on the level of congruency with these values. This risk seems specifically relevant in uncertain tasks such as knowledge integration in really new product development. In performing this task, managers often lack 'hard numbers' in making decisions and consequently are more likely to rely on intuition and rule of thumb. These heuristics seem more likely to reflect one's beliefs, emotional commitments and ideology, increasing the risk of buffering of new information that is not compatible with the group's core values.

In sum, it can be argued that, generally, cross-functional integration, which consists of both cross-functional collaboration and interaction, is beneficial for the dissemination and usage of market information in really new product innovation and therefore for its performance. However, a small group of studies has highlighted possible negative effects of cross functional integration, such as a decrease in creativity and the development of groupthink.

2.3.4 Summary

Overall, the marketing literature is well positioned to participate in the initial understanding of how firms could resolve the market learning paradox in the course of really new product innovation projects. We presented that a firm's market orientation, which largely refers to processing information on customer needs, has the potential to increase the effectiveness and efficiency of really new product innovation. This statement is specifically true for the types of product innovation

that do not heavily diverge from markets that are familiar to the firm. This section also discussed four broad categories of organizational antecedents of market oriented really new product innovation: marketing function, senior management factors, market information generation methods, and cross-functional integration. It was proposed that to develop a marketing orientation in really new product innovation, an organization's senior management should express a flexible strategic mission and demonstrate some willingness to take risk which is complemented by a certain tolerance for failure. Furthermore, a specialized marketing function should be present in the project, project members should make use of experiential interaction with (potential) customers, and the marketing function should have some level of integration with other relevant product innovation functions. However, in line with the product development literature, the marketing literature uses a relatively high level of abstraction and has little evidence to offer on how firms resolve the market learning paradox in the course of single really new product development projects.

The next chapter presents an integration of the three streams of literature that were discussed in this chapter. Together they form the input for developing a conceptual framework that can guide detailed empirical data analyses on how organizations resolve the market learning paradox in the course of single really new product development projects.

3 Towards a conceptual framework

This chapter describes our choices on theoretical perspectives, concepts, and relationships between concepts in constructing a conceptual framework. This framework will be used as starting point for empirical analyses. In developing the framework, we consider the knowledge and organizational learning stream of literature as focal research stream. As a consequence, we also use its terminology. For instance, we use the terms 'generation', 'integration' and 'market knowledge', to point to knowledge dynamics instead of the 'generation' and 'dissemination' of 'market intelligence', and the 'responsiveness' to it as is used by the marketing literature. First an outline of concepts and several working assumptions are discussed. In conclusion we present a schematic overview of the conceptual framework.

3.1 Market learning in really new product innovation

In this section, we define the central concepts 'really new product innovation', 'exploration in market learning', and 'exploitation in market learning' and clarify several working assumptions that resulted from studying the existing literature (table 3.1).

Based on the literature that was discussed in the previous chapter, we define really new product innovation as 'the development of a product that is underpinned by, at least, some knowledge that is new to the firm'. Following the accumulation of work on product innovation processes (Cooper and Kleinschmidt 1986; Hauser et al. 2006), really new product innovation is seen as an organizational process consisting of three process steps: the *initiation* of a new product idea (the front end), the actual *development* of the product (the middle), and its *commercialization* (the back end). Although it is acknowledged that really new product development often follows a process that is less structured and non-linear, we still will use a linear approach for conceptualization. A linear approach is relatively simple, generally accepted, and it provides a sufficient basis for anchoring the multifaceted phenomenon of resolving the market learning paradox in product innovation. Indeed, support for such reasoning can be found in the literature. Gobeli and Brown (1993), for instance, suggest that although there is often lack in structure, clustering innovation activities into stages gives a common and practical format for discussing problems and solutions. Likewise, Veryzer (1998a) argues that although really new product innovation seems to be an inherently messy process, from a certain perspective there is still a logical progression in how it is managed.

Furthermore, based on reviewing studies from the product development literature (Eisenhardt and Tabrizi 1995; Lynn et al. 1996; Moorman and Miner 1997; Song and Montoya-Weiss 1998), we assume that development organizations active in effective and efficient really new product innovation will use *'learning by doing'* as the overall working strategy. Although some planning may still be favorable, the basic orientation is experimental. The underlying idea is that in the situation of really new product innovation, where the product innovation outcome is largely unknown, it is not helpful to plan extensively. Rather maintaining flexibility and learning quickly through improvisation and experience yield effective performance.

Table 3.1: Defining really new product innovation and market learning

Concept	Definition	Product development literature	Organizational knowledge and learning literature	Marketing literature
Really new product innovation	The development of a product that is underpinned by, at least, some knowledge that is new to the firm	Three main phases: initiation, development, and commercialization; 'Learning by doing' as working strategy		
Exploration in market learning	The generation of market knowledge that is new to the firm and its integration in the product development project		The generation of knowledge that is new to the firm and its integration in the product development project	The generation and dissemination of market intelligence and the responsiveness to it by the development organization Market intelligence can have multiple dimensions such as segment and customer need information
Exploitation in market learning	The updating of market knowledge that exists in the firm and its integration in the product development project		The updating of knowledge that exists in the firm and its integration in the product development project	The generation and dissemination of market intelligence and the responsiveness to it by the development organization Market intelligence can have multiple dimensions such as segment and customer need information

Additionally, the marketing literature has addressed that project effectiveness and efficiency can be enhanced when the development organization and other organizational members are oriented towards the market (Atuahene-Gima 2005; Atuahene-Gima et al. 2005; Baker and Sinkula 2007; Callahan and Lasry 2004; Kyriakopoulos and Moorman 2004; Narver et al. 2004). In the context of product innovation, market orientation can be captured by three process steps: the generation of intelligence from the market, its dissemination throughout the organization, and the responsiveness to it by the development organization. In the terminology of organizational knowledge and learning, that we decided to put central in the framework, this behavior is similar to marketing learning which is described as the two step process of the *generation* of market knowledge[16] from the environment

[16] In our view, because market knowledge refers to a firm resource instead of a firm capability, it is clearly a form of 'know-what' and not of 'know-how'.

and its *integration* in the product development project (Allen 1971; Ancona and Caldwell 1992; Atuahene-Gima and Murray 2007; Grant 1996b; Li and Calantone 1998).

Mainly based on further insights from the organizational knowledge and learning literature, we take a detailed perspective and focus on changes in knowledge resources that underpin really new product innovation. We assume that market learning in the course of successful really new product innovation projects entails two types of learning: *exploration* and *exploitation*. Exploration in market learning refers to 'the generation of market knowledge that is new to the firm and its integration in the product development project'. Exploitation, in contrast, is about 'updating market knowledge that already resides in the firm and integrating it in the product development project'. Although some might argue that really new product development is by definition a sole act of exploration, this research follows scholars claiming that both types of learning are necessary in this process (Atuahene-Gima 2005; Cheng and Van de Ven 1996; Danneels 2002; Katila and Ahuja 2002; Kyriakopoulos and Moorman 2004; McGrath 2001). It is assumed that the majority of really new product ideas combine knowledge resources that already reside in the firm with knowledge that is newly generated. In these cases, existing knowledge provides the necessary absorptive capacity to use new knowledge. Still, even if really new product ideas are purely based on exploration, we assume that exploitation is needed as well: the newly generated knowledge has to be refined and developed to the extent that the product is ready for market introduction (Cheng and Van de Ven 1996; McGrath 2001). Hence, to successfully generate really new product ideas, develop the really new product, and introduce it into the market, it is maintained that organizations need to build up market knowledge that is new to the firm (i.e. exploration) *and* update the market knowledge base that was already developed (i.e. exploitation). The two types of market learning fulfill complementary roles in the context of really new product development projects (Moorman and Slotegraaf 1999).

Finally, building on joint insights from the marketing literature and research on organizational knowledge and learning, it is assumed that market knowledge in successful really new product innovation is a *diverse knowledge resource* that includes, at least, two loosely coupled knowledge dimensions: market segment knowledge and customer need knowledge (Adams et al. 1998; Turner and Makhija 2006; Veldhuizen et al. 2006). Based on this assumption, it is deemed possible that development organizations can combine exploration and exploitation across market knowledge dimensions in a single period in time. For instance, exploration in market segment knowledge might be combined with exploitation in customer need knowledge in the project's initiation phase. Furthermore, taking the 'learning by doing' strategy and the need for additional market knowledge in the later process phases into account (Veldhuizen et al. 2006), we assume that it is also possible to combine exploration and exploitation over time (Gupta et al. 2006). For instance, in the same project, exploration in customer need knowledge in the initiation phase might be combined with exploitation on the same knowledge dimension in the development phase.

In sum, building up to our conceptual framework, we make the following four assumptions on market learning in really new product innovation:

1. Really new product innovation is a process that can be subdivided into three phases: initiation, development, and commercialization, and a suitable working strategy is 'learning by doing'.
2. The effectiveness and efficiency of really new product innovation projects can be enhanced when the development organization is active in market learning, which refers to the generation and integration of market knowledge.
3. Market learning in really new product development consists of a combination of exploration and exploitation.
4. Because market knowledge can be a diverse resource having, at least, two dimensions, combining exploration and exploitation can take place in a single period in time (i.e. single product development phase) and over time (i.e. multiple product development phases).

3.2 Resolving the market learning paradox in product innovation

As argued before, firms have to combine exploration and exploitation in market learning to be successful in really new product innovation. However, this remains a difficult task. Exploration and exploitation represent fundamentally contradictory project strategies and are associated with different and inconsistent mental models, skills and processes (March 1991; Van de Ven et al. 1999). Combining these learning tasks represents a tension between old and new. It embodies a struggle between the comfort of the past and the uncertainty of the future. While exploration results in variation, exploitation benefits the selection and retention stages of the learning cycle (Zollo and Winter 2002). As such, market learning in really new product development projects presents a learning paradox: the simultaneous presence of contradictory elements (Lewis 2000; Poole and Van de Ven 1989; Quinn and Cameron 1988).

In this research, we assume that firms resolve the market learning paradox in the course of really new product innovation projects by putting *ambidextrous marketing organizations* in place (Duncan 1976; Tushman and O'Reilly 1996). The empirical part of the research will be used to gain further insight into these organizational configurations. For developing our framework we use a *configurational approach* which maintains that organizations can be better understood via identifying distinct, internally consistent sets of dimensions than by seeking to uncover relationships between single elements (Short et al. 2008; Tidd 2001).

When analyzing the organization of marketing activities, one can look at various dimensions, including division of tasks, formalization, centralization, power, and cross-functional interaction (Workman et al. 1998). In a first attempt to identify core organizational design dimensions for ambidextrous marketing organizations, we rely on several broad organizational concepts that can be put forward when combining the three streams of literature that were discussed in the previous chapter (Table 3.2). We further assume that we will be able to detail these concepts based on our empirical analyses. A similar approach, for instance, was adopted to develop the well-known Miles and Snow (1978) typology. The final result of these authors was partly based on theories on strategic choice and enactment, and partly based on the authors' qualitative research in the textbook industry (Ketchen 2003).

Table 3.2: Defining organizational concepts

Concept	Definition	Product development literature	Organizational knowledge and learning literature	Marketing literature
Marketing function	The organizational task(s) of the project member(s) that link(s) a really new product development project to 'the market'	The marketing function is part of the development organization	The marketing function can be integrated in, or differentiated from, the mainstream organization	A specialized marketing function is beneficial for achieving a market orientation
Senior management involvement	The involvement of senior management in market learning in the context of a really new product development project	The performance of really new product development is enhanced when senior management uses a combination of support and control	To support combining exploration and exploitation, senior management • develops an overall strategic intent; • integrates exploration and exploitation; • implements supporting strategies and systems; • promotes ambidextrous ideas that emerge bottom up.	To support market oriented really new product development, senior management • articulates a flexible strategic mission; • shows willingness to take risks, and combines that with a certain tolerance for failure.
Market knowledge generation	Practices used to generate market knowledge in the context of a really new product development project		Knowledge generation is supported by practices that • establish inter-firm connections; • enhance inter-firm tie strength; • develop shared language and narratives between firms.	To support market oriented really new product development, project members should • mix primary and secondary data generation techniques; • experimentally interact with (potential) customers.
Market knowledge integration	Practices used to integrate market knowledge in the context of a really new product development project		Knowledge integration is supported by practices that • establish intra-firm connections; • enhance intra-firm tie strength; • develop shared language and narratives between functions.	The dissemination and usage of market intelligence in the context of a really new product development project is supported by cross-functional integration

In the following sections we will discuss four organizational concepts that, assumingly, are important features of ambidextrous marketing organizations: marketing function, senior management involvement, market knowledge generation, and market knowledge integration.

Marketing function

Marketing function is defined as 'the organizational task(s) of the project member(s) that link(s) a really new product development project to the market'[17]. Essentially, this concept is about organizational structure. Based on the marketing literature and studies in the field of organizational knowledge and learning, we assume that the marketing function in ambidextrous marketing organizations can further be detailed by its levels of specialization and integration in the mainstream organization.

Findings from the marketing literature point in the direction that development organizations that include a specialized market function will be more active in market learning than their counterparts that rely on non-specialists (Becker and Lillemark 2006; Rust and Moorman 1999; Veryzer 2005; Workman 1998; 1993). Additionally, based on findings from the research in the field of organizational knowledge and learning, there are basically two structural options for organizations to become ambidextrous. The first option is to develop a unit for exploration that is structurally differentiated from the mainstream organization and to combine this with tactical integration mechanisms (Benner and Tushman 2003; Christensen 1997; Tushman and O'Reilly 1996). The second option is to keep the exploration unit structurally integrated in the mainstream organization and mix this with tactical differentiation mechanisms (Adler and Borys 1996; Adler et al. 1999; Ghoshal and Bartlett 1994; Gibson and Birkinshaw 2004; McDonough and Leifer 1983; Sheremata 2000). Based on the literature, we do not have a theoretical rationale on what form to expect for ambidextrous marketing organizations in the context of really new product innovation. For now, we assume both options to be equally feasible.

Senior management involvement

Senior management involvement refers to 'the involvement of senior management in market learning in the context of a really new product development project'. In this case, senior management is a group of organizational managers who are involved in strategic product planning and the allocation and control of product innovation resources, but are not, like project members, involved in day-to-day project activities. In most cases these managers belong to the top management team of the organization or are their direct reports such as product managers. In essence, senior management involvement is about organizational leadership.

Based on insights across the three streams of literature that were studied, we assume that the characteristics of senior management (non)involvement will have an impact on an organizational marketing organization becoming ambidextrous. The product development literature, for instance,

[17] 'Project member(s)' refers to the organizational employees that are part of the development organization and are therefore active in day-to-day product innovation activities. In this research we also refer to them as 'functional specialists'.

has shown that a right balance of senior management support and control has a positive impact on implementing really new product innovation (Bonner et al. 2002; Brown and Eisenhardt 1995; Cardinal 2001; Lewis et al. 2002; Swink 2000). In turn, the marketing literature has underlined that senior management's emphasis on both responsive and proactive market orientation, via the expression of a flexible strategic mission, and willingness to take risk, complemented by a certain tolerance for failure, supports market oriented really new product innovation (Adams et al. 1998; Atuahene-Gima et al. 2005; Christensen and Bower 1996; Jaworski and Kohli 1993; Kirca et al. 2005). Finally, the literature on organizational knowledge and learning regards senior managers as playing an important role in resolving organizational learning paradoxes and fostering organizational ambidexterity. In situations where units for exploration and exploitation are highly differentiated, this literature argues that senior management should develop an overall and compelling strategic intent that justifies the importance of both exploration and exploitation. Furthermore, senior management should have a large stake in integrating exploration and exploitation across the two separate units (O'Reilly and Tushman 2008; Smith and Tushman 2005; Tushman and O'Reilly 1996). Also when employees who are responsible for exploration are more integrated in the mainstream organization, it is argued that senior management involvement is important. As key leaders in organizations they should put in place strategies and systems that shape the exploration and exploitation behavior of individuals (Ghoshal and Bartlett 1994; Smith 2006) or play a more catalytic role, in which they promote ambidextrous ideas that emerge bottom up (Floyd and Lane 2000; Gibson and Birkinshaw 2004).

Market knowledge generation

Market knowledge generation is defined as 'practices used to generate market knowledge in the context of a really new product development project'. It refers to what practices are used to take the first step in a market learning cycle. Based on indications from the marketing and organizational knowledge and learning streams of literature, we assume that the practices that are (not) used to generate marketing knowledge have an impact on a marketing organization becoming ambidextrous.

For market knowledge generation in really new product innovation, specifically the marketing literature has recommended that organizations should mix primary and secondary data generation techniques to collect information on market segments and customers. In particular it is recommended that development organizations should use experiential interaction with (potential) customers because it is this interaction that will yield marketing knowledge that is new to the firm. This interaction requires a non-competitive attitude towards knowledge sharing from the focal firm and its (potential) customer. It should take the form of using experiential market research techniques, such as 'emphatic design' or testing product prototypes. These can cross cognitive boundaries and transfer knowledge that is often highly tacit in nature (Hamel and Prahalad 1994; Leonard 1995; Lynn et al. 1996; O'Connor 1998; Slater and Mohr 2006; von Hippel 1986). Additionally, the literature on organizational knowledge and learning has argued that knowledge generation from the organizational environment benefits from implementing practices that can establish connections, enhance tie strength, and develop a shared language and narratives between

firms (Cohen and Levinthal 1990; Hansen 1999; Inkpen and Tsang 2005; Lane et al. 2006; Nahapiet and Ghosal 1998).

Market knowledge integration

Market knowledge integration is defined as 'practices used to integrate market knowledge in the context of a really new product development project'. It refers to what practices are used to take the second step in a market learning cycle: the integration of market knowledge with other relevant knowledge resources in product innovation. Based on indications from the marketing and organizational knowledge and learning streams of literature, we assume that the practices that are (not) used to integrate marketing knowledge have an impact on a marketing organization becoming ambidextrous

The marketing literature has argued that market knowledge integration is, generally, supported by cross-functional integration. In turn, cross-functional integration can be achieved by installing practices that enhance cross-functional interaction, such as meetings or other ways of information exchange, and cross-functional collaboration (Atuahene-Gima and Murray 2007; De Luca and Atuahene-Gima 2007; Griffin and Hauser 1996; Olson et al. 1995). Additionally, the literature on organizational knowledge and learning has argued that knowledge integration inside the firm benefits from practices that can establish connections, enhance tie strength, and develop a shared language and narratives between functions (Gupta and Govindarajan 2000; Hansen 1999; Inkpen and Tsang 2005; Nahapiet and Ghosal 1998; Szulanski 1996).

In sum, building up to our conceptual framework and based on joint insights from the streams of literature that were discussed in the theoretical background, we assume that the core organizational design dimensions for ambidextrous marketing organizations in the context of really new product innovation are, at least, made up by the concepts: marketing function, senior management involvement, market knowledge generation, and market knowledge integration. Furthermore, it is taken into account that, just as the exploration/exploitation nature of learning processes, also the ambidextrous marketing organization can change in the course of a product innovation project.

3.3 The conceptual framework

A schematic overview of the conceptual framework which will guide empirical analyses is presented in figure 3.1. Based on the review of the existing literature it is assumed that market learning in successful really new product innovation consists of combining exploration and exploitation in the course of the product innovation process. Furthermore, it is assumed that organizations can only deal with this paradoxical requirement if they install ambidextrous marketing organizations. These marketing organizations are organizational configurations which are, at least, made up of the broad and interrelated concepts of marketing function, senior management involvement, market knowledge generation, and market knowledge integration. We will detail these concepts based on our empirical analysis. Figure 3.1 illustrates our assumptions in a schematic overview.

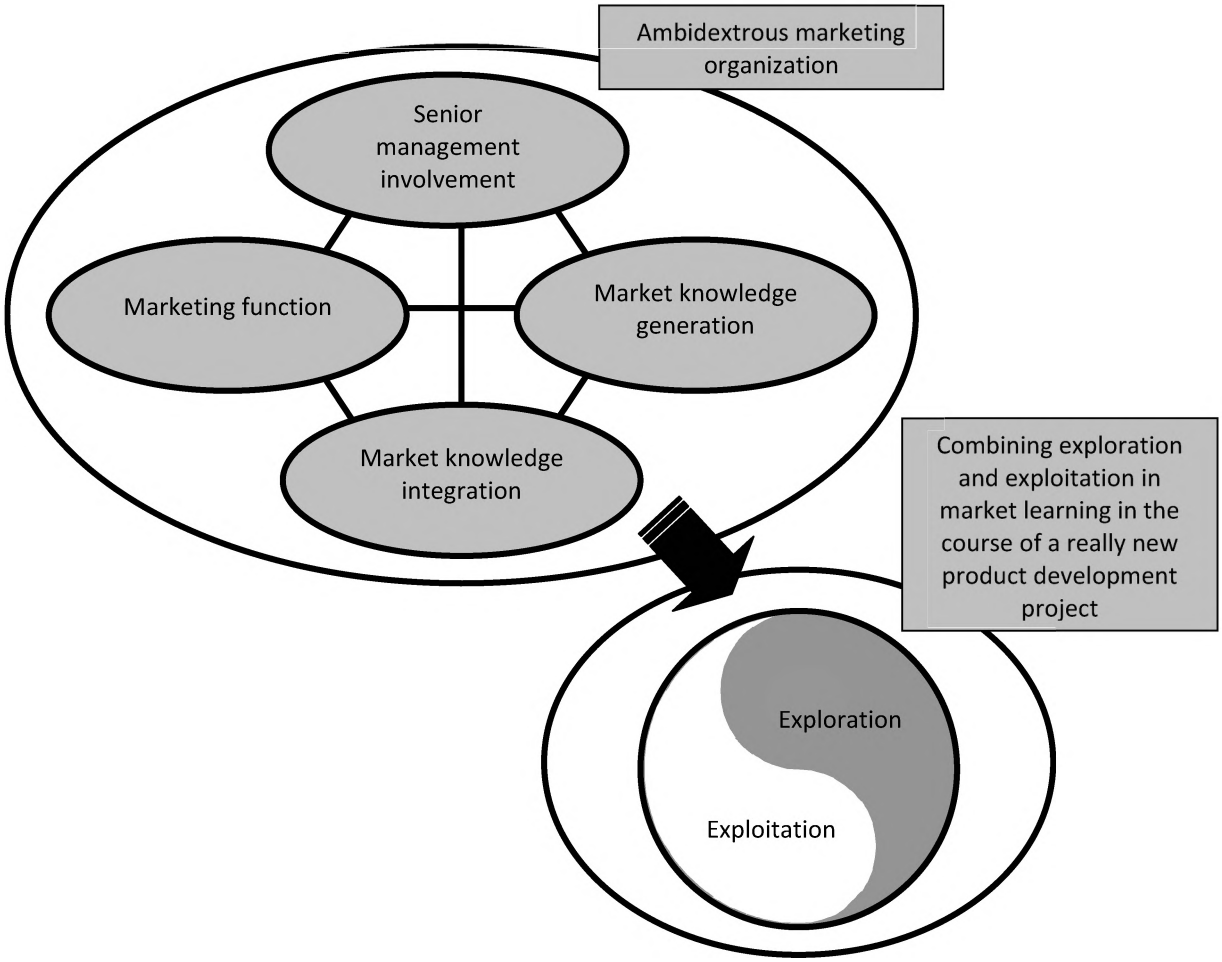


Figure 3.1: Conceptual framework

Part II
Empirical study

4 Methodology

The purpose of this chapter is to discuss the research design and outline of the empirical study. The first section explains what research strategy is most appropriate in which situations. Then it concludes that case study research is appropriate for this research and looks deeper into the nature of this strategy and how it is used in this research. Subsequently, the research setting, case selection, data collection, coding and data analyses, and presentation of findings are discussed. Finally, this chapter focuses on the rigor of this research.

4.1 Choosing a research strategy

Yin (1994) distinguishes several major research strategies that are used in social science: experiments, surveys, archival analysis, histories, and case studies. Even though each method has its distinctive characteristics, there are often areas of overlap amongst them. Consequently, the endeavor in choosing a research strategy is to avoid gross misfits. Although there are no universal answers on when to use what research strategy, the literature provides several guidelines.

In general, surveys and archival analysis on quantitative data are advantageous when research aims to describe the prevalence of a phenomenon, to be predictive about certain outcomes, and to answer questions about the relative empirical importance of constructs (Eisenhardt and Graebner 2007; Yin 1994). In contrast, 'how' and 'why' questions usually focus on explaining a phenomenon which will most likely lead to the use of histories, case studies, and experiments. Such questions often deal with operational links that have to be traced over time, rather than mere frequencies or incidences (Bonoma 1985; Lee 1999; Yin 1994).

In addition, the phenomenon of interest is of importance (Yin 1994). Assuming that 'how' and 'why' questions are the focus of study, a further distinction between histories, case studies, and experiments is largely based on the extent of access and control the researcher has to the events under study. Histories fit situations in which there is little access and control. This strategy deals with historical events or 'dead' pasts. No relevant informants are alive to report on the phenomenon and researchers must rely on documents and artifacts as the main sources of evidence. The case study is preferred in examining contemporary events in situations where there is no significant need or desire for control over behavior. The case study relies on many of the same techniques used in histories but adds two potential sources of evidence: direct observations and systematic interviewing. Therefore, its unique strength is to deal with a full variety of evidence, beyond that what is available in the conventional historical study, which allows for a holistic portrayal of the phenomenon under study. Experiments are the method of choice when the researcher studies contemporary events and wants to have significant control over behavioral events. Experiments can take place in a laboratory or a field setting where behavior is manipulated in a direct, precise and systematic manner.

Finally, for some 'how' and 'why' questions that relate to contemporary events in which there is no significant need or desire for control over behavior, the choice of research strategy is somewhat ambivalent (Bonoma 1985; Eisenhardt and Graebner 2007; Yin 1994). While the reasoning presented

above points to a case study strategy, sometimes a survey or archival analysis of quantitative data is the preferred methodology. A rule of thumb is the availability of theory. If the research question can be answered based on well developed theory, a survey or archival analysis might fit. If existing theories either do not address the research question at all or do so in a way that is inadequate, a case study may be appropriate. Thus, if much is already known, or if what is unknown is very explicit, experience can be gained via limited interactions with research subjects. However, if little is known, or if issues are vague or complex, more extensive interaction may be required to gain necessary experience (Calder 1994).

Based on the guidelines presented above, we have decided to use a case study strategy for this research. First of all, this research answers a 'how' question to explain the event of resolving the market learning paradox in product innovation. Additionally, this research studies a complex phenomenon (i.e. organizational learning) that takes place in a complex and dynamic social setting (i.e. product innovation in established firms). Looking into such multifaceted events benefits from extensive interaction with research subjects by which event sequences can be clarified, overlapping causal factors disentangled, and contexts can be taken into account (Langley 1999; Lee 1999; Pettigrew 1990). Finally, because there is little detailed research on how firms resolve the market learning paradox in product innovation a primary motivation for this study is to contrast pre-existing understandings with observed empirical events to re-conceptualize and extend existing theories.

4.2 Definition and background of case study research

This section focuses attention on the definition and background of case study research, which is the strategy of choice in this research. We will briefly discuss its definition and forms, and the role of theory.

Case studies: definition and forms

Until now, we have progressed without a formal definition of case study research. In adopting a definition Yin (1994: 13) provides insights. This author formulates the scope of this strategy as follows: 'A case study is an empirical enquiry that investigates a contemporary phenomenon within its real-life context'. Case studies should be seen as a comprehensive research strategy with specific approaches towards data collection and data analysis. They are not limited to a certain data collection method and can include in-depth interviews, archival data, questionnaires, and observations.

In general, a distinction is made between conducting single or multiple case studies (Eisenhardt and Graebner 2007; Yin 1994). The main factors determining this choice are the purpose of research, the research questions, and research conditions. Single cases are often chosen because they are unusually revelatory, extreme exemplars, or opportunities for unusual research access (Eisenhardt and Graebner 2007; Yin 1994). An example is Weick's (1993) well-known use of the extreme case of lost sensemaking of fire-fighters in the disaster at Mann Gulch. Dyer and Wilkens (1991) add that a single case study focuses attention on the unique and typical characteristics of the particular social scene. While single cases can richly describe the existence of a phenomenon, multiple case studies

typically provide a stronger base for robust theory building and theory extension (Eisenhardt 1991; Glaser and Strauss 1967; Yin 1994). Multiple cases can be considered as discrete experiments to serve as replications, contrasts and extensions of theoretical insights. Moreover, involving multiple cases contains lower risk that data are insufficient when a specific case does not live up to expectations.

This research is concerned with combining and extending theory, rather than focusing attention on a very unique social scene or situation. Therefore, based on the discussion presented above, we have chosen to carry out multiple case studies[18].

Case studies and the role of theory

The role of existing theory in case study research heavily depends on the nature of the research question (Eisenhardt and Graebner 2007). If the research question is phenomenon-driven, the researcher has to frame the research in terms of importance of the phenomenon and the lack of plausible existing theory. In these situations existing theory plays a limited role and, at the extreme, propositions draw on data alone, resulting in 'grounded theory' (Glaser and Strauss 1967). Somewhat more focus is achieved by a priori specification of some concepts of potential importance (Eisenhardt 1989). If these constructs remain important as the research progresses emerging theories have a firmer grounding. However, the downside of this approach is that it may tip over to a premature specification of relationships which may bias and limit eventual findings.

In situations of theory-driven research questions, the researcher has to frame the research within the context of more specific theory. In these contexts, a theoretical framework plays a more prominent role in a sense that it has more impact in guiding empirical work than in phenomenon-driven research. Empirical data gathered through case studies is used to re-conceptualize and extend existing theory (Burawoy 1991). In contrast with the grounded theory approach, the researcher examines the literature relevant to a specific problem area, and employs the empirical data to fill in its gaps, reveal its flaws, elaborate its meaning, and extend its coverage.

Our research is rather theory-driven. Theory on market orientation and product development is enriched with theory on organizational knowledge and learning. Within the boundaries of these theories, a conceptual framework is developed based on several theoretical assumptions. Empirical data from the case studies is used to refine this framework and extend insights on how firms resolve the market learning paradox in the course of really new product development.

4.3 Research setting

This section discusses the research setting, which is the chemical industry. It focuses on the motivation for choosing a single industry and why the chemical industry was chosen. It also provides

[18] Additionally, because our work is concerned with theory combining and extension aiming at laying the groundwork for testing propositions across cases, it is related with a rather objective view on case study research. This view is different in terms of research activities, goals, and epistemology than the perspective that sees case study research as strategy to give 'thick descriptions', emphasize the social construction of reality and focuses on revealing how extant theory operates in particular examples (Eisenhardt and Graebner 2007; Gibbert et al. 2008).

information on the industry background. This section is partly based on literature and partly based on in-depth interviews with seven industry experts that were interviewed on the nature of the industry (table 4.1).

Table 4.1: Consulted industry experts

Role in the industry	Years of experience in the industry
R&D manager of multinational	30+
Director business development of multinational	18
Director European trade organization	30+
Operational manager research consortium	5
Editor-in-chief Dutch trade journal	10
Consultant	12
Consultant	30+

Motivation

The research setting of the study is limited to the context of the chemical industry. Although the choice of a single industry limits the generalizability of the results, it also reduces problems that arise when sampling from different industries. Different industries increase extraneous sources of variance which have to be controlled for when examining firm level phenomena (Bass et al. 1978). Specifically, the central elements in this study, such as organizational innovation processes and the nature of knowledge resources, have proven to differ substantially across industries (King and Zeithaml 2003; Pavitt 1984; Souitaris 2002; von Krogh et al. 1994). The need for controlling extraneous sources of variance can distract from identifying a robust set of firm-level variables, specifically when samples are small such as in case study research. Additionally, working with data from single industries is not uncommon in research on market oriented innovation and has led to relevant insights (see e.g. Bruni and Verona 2009; De Wit et al. 2007; Kyriakopoulos and Moorman 2004; Sorescu et al. 2003).

The chemical industry was chosen as research setting because it is an important manufacturing industry. Its European sales figure was 333 billion Euros in 2007 (CEFIC 2009) (1.2% of total GDP), and it enables innovation in wide variety of downstream value chains (König et al. 2006). The industry is relatively established with defined boundaries which increased the likelihood that a comprehensive inventory of knowledge resources could be identified (King and Zeithaml 2003). Additionally, really new product innovation is of high strategic importance in this industry, which is highlighted by the chemical industry being subject to some classical product innovation studies (Cooper and Kleinschmidt 1993; Rothwell 1972). Finally, working together with (potential) customers in product innovation is essential for bringing new chemical products to the market. In a lot of product categories, new chemical products are specialties that have to be tailored to specific customer needs. Moreover, the role of marketing in product innovation, relative to research, has increased in recent decades. The chemical industry has moved from 'high' to 'medium' tech in industry classifications (Hatzichronoglou 1997; Mizik and Jacobson 2003), has increased its attention towards finding new applications for existing technologies (König et al. 2006), and has become more focused on product quality and customer satisfaction (Walsh and Lodorfos 2002). As one of the industry experts put it:

'The general shift that I see in our company, is a shift from research and production knowledge towards knowledge on different product applications.'

Industry background

The chemical industry is a capital intensive process industry which creates and transforms chemical substances to provide the market with functionally advantageous non-assembled products. It is dominated by large multinationals, has its roots in Europe, and is over a hundred years old (Barnett and Clark 1996; Cesaroni et al. 2004; Mahdi et al. 2002; Pisano 1997; Stobaugh 1988; Van Gils 2010).

At its foundation, growth was mainly based on developments in organic chemistry. Firms that mastered this general purpose technology diversified into product markets such as pharmaceuticals, explosives, and photographic materials (Hofmann and Budde 2006). The next wave of development was heavily supported by progress in polymer chemistry which started in the 1920s (Cesaroni et al. 2004). Polymer chemistry provided a common technology base to develop six distinct new product markets: plastics, fibers, rubbers, elastomers, surface coatings, and adhesives.

During the 1950s and 1960s, the industry showed strong expansion (Arora and Gambardella 1998). The demand for chemical products grew rapidly as a result of increasing substitution of natural products. Plastics, in particular, replaced products such as paper, wood, or cotton in many applications, as they were cheaper and easier to process. Additionally, chemical companies began to spread outside their home markets and true multinational organizations began to emerge.

Throughout the 1970s and 1980s, many firms in the industry were confronted with excess capacity. Demand leveled-off and concerns about 'limits to growth' suggested that feedstock (i.e. oil) was running out (Achilladelis et al. 1990; Walsh and Lodorfos 2002). Additionally, on the supply side, the growth rate of technological opportunities based on traditional chemistry slowed down. It became harder for companies to grow faster than the average manufacturing industry, and many were forced to control costs (Arora and Gambardella 1998). The chemical industry entered an era of rationalization and restructuring, and lots of firms narrowed their business portfolios. Western firms moved out of their commodity markets and increased their focus on product quality and customer satisfaction in a limited number of markets (Walsh and Lodorfos 2002).

Merger and acquisition activities still continue today. They are mainly driven by the need of established players to focus on the most promising parts of their portfolios and create shareholder value (Hofmann and Budde 2006). These moves are complemented by geographical expansion making chemicals a truly global industry with world-scale oligopolies (Arora et al. 2004). The industry in its contemporary form can be roughly divided into three strategic groups [19,20]: (1) firms that are

[19] We restricted the chemical industry to the C20 NACE code. In our view, the chemical industry does not include the petrochemical arms of the large oil companies because developing and producing chemicals can not be considered as their core business. The same argument holds for food processing, pharmaceutical, and downstream chemical or material processing firms.

[20] Very large corporations, such as BASF, DOW Chemical, and DuPont, are often active in more than one strategic group.

focusing on commodity chemicals and materials (e.g. LyondellBasell); (2) firms that focus on specialty chemicals and materials (e.g. DSM); (3) and firms that focus on agrochemicals (e.g. Monsanto).

What will the future bring for the chemical industry? Spitz (2003) argues that it is possible that it becomes tomorrow's steel industry with only a few players left. Also tomorrow's textile industry is mentioned, which comes with the migration from industrialized countries to Asia and the Middle East. Several European initiatives (e.g. ECMSA's scenarios 2010, a vision for the UK chemicals industry, and CEFIC's European Chemicals Industry Scenarios Horizon 2015) have taken place to build up a vision for the industry. All these initiatives identify product development and innovation as one of the most important drivers for a positive future of the European chemical industry (Heinzelbecker 2005). Concerning technology-based product innovation, that has always been the main focus of the chemical industry, new opportunities are rising along the lines of emerging fields such as biotechnology, and nanotechnology. Additionally, non-traditional types of product innovation, such as finding new applications for existing product technologies and adding services, have gained attention (König et al. 2006).

4.4 Case selection

This section discusses case selection. It focuses specific attention on defining the unit of analysis, selecting organizations, and the selection of really new product innovation projects as main cases.

Unit of analysis

The main unit of analysis is the really new product innovation project in chemical firms. This small unit of analysis helps to focus data collection because it allows for studying well defined organizational events (Yin 1994). However, really new product innovation projects are not viewed in this study as self-containing units of analysis, but as visible arenas for the interaction between old and new *organizational* market knowledge. Thus, dynamics in organizational resources are placed under a magnifying glass by studying market learning in individual projects. As Pettigrew (1990: 269) put it, the research focuses on both 'vertical and horizontal organizational levels of analysis and the interconnections between those levels through time'. This approach is not uncommon. Comparable studies focusing on the interface between product innovation projects and the organization are, for instance, Leonard-Barton (1992), and Danneels (2002; 2007).

Selecting organizations

We started case selection by compiling a list of chemical companies and contact details using membership lists of trade organizations (e.g. VNCI in The Netherlands), research consortia (e.g. DPI in The Netherlands), and the European Industrial Research Management Association. Selection criteria were that the companies (1) had a significant presence in The Netherlands, Germany or Belgium for reasons of accessibility; (2) had a significant size (over 100 million Euros in sales revenue). After negotiating access, we were able to work with six chemical companies. Because prior research has shown that most marketing and product innovation activities take place at the level of the business

unit (Adler et al. 1999; Brown and Eisenhardt 1997; Piercy 1985; Workman et al. 1998), one business unit, instead of the corporate level[21], was selected as organizational context The size of these business units ranged from 270 to 4,800 million Euros in annual sales revenue with an average size of 1,300 million Euros.

Selecting really new product innovation projects as cases

The second step in case selection was selecting really new product innovation projects as main cases. With regard to case selection, Eisenhardt (1989: 545) suggests that a 'number between 4 and 10 cases usually works well'. When fewer than 4 cases are selected it is often difficult to develop convincing theory but with more than 10 cases there is a substantial risk to end up with data overload.

Instead of random or stratified sampling from a population as is common in large-scale hypotheses testing research, case study sampling is often based on theory (Eisenhardt 1989; Glaser and Strauss 1967; Yin 1994). As mentioned above, we were interested in studying how mature firms resolve the market learning paradox in the course or really new product innovation projects. To arrive at general answers, a wide variety of really new product innovation projects was required. Based on theory (Abernathy and Clark 1985; Garcia and Calantone 2002; Tushman and Smith 2002) and the in-depth interviews with industry experts discussed above, three really new product categories were developed alongside a technology and market axis. In combination these categories cover the total available really new product space.

As a process industry, the chemical industry is characterized by the interrelated nature of product and process technology (Barnett and Clark 1996; Pisano 1997). Changes in one or both of these types of technology can have a significant impact on product properties. Therefore, regarding the technology axis, both are considered. Product technology refers to the chemistry that underlies a product, such as the structure of molecules, while process technology refers to process control, such as the temperature of a reaction. The market axis focuses on the application market, which refers to the downstream application in which the product is used, such as a specific vehicle part. Really new product categories are defined relative to the underlying product/process technology and the market application of existing business unit products (figure 4.1).

[21] All companies in the research are multi-divisional.

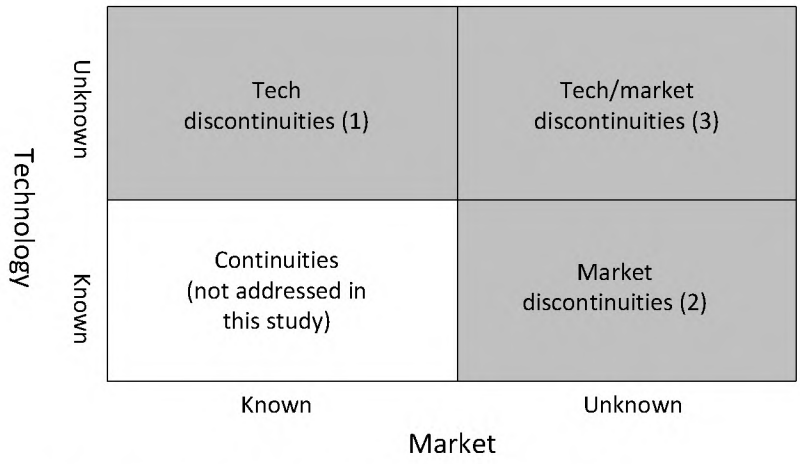


Figure 4.1: Three distinct really new product innovation project categories

The first category is labeled *Tech-discontinuities*. The product innovation projects in this category are based on product and/or process technologies that are new to the business unit and are focused on existing application markets. The second category contains *Market-discontinuities*. Projects in this category are based on the business unit's existing product and process technologies and focus on new application markets. The final category, *Tech/market discontinuities,* refers to projects that are based on both new technologies *and* focus on new application markets.

Concerning sampling, we followed the logic of contrary replication and replication (Yin 1994). Our aim was to study one project in each category (i.e. contrary replication) in three business units of different organizations (i.e. replication). We also aimed to study projects of which the output was just before market introduction, or had been introduced into the market less than two years ago. The rationale for this second requirement was that studying long finished projects would reduce the chances of contacting suitable respondents and the ones that could be contacted might have severe problems of remembering the details of the project (Huber and Power 1985). These requirements proved not completely feasible in the time available. Three initial business units, Alpha, Beta, and Gamma, could deliver seven projects which were studied in parallel. Then we filled the gaps with three additional projects from three other business units. The total sample consisted of ten projects in six business units of six different chemical firms (figure 4.2).

The outputs of these projects, the actual products, had been introduced into the market less than three years ago (*Heat*, *Green*, *Gears*, *Diffuse*, *Additive*, *Anti-resist*, *Foam*, *Dye*) or were close to market introduction (*Anti-tracking* and *Bond*). Because it is not easy to set up really new product innovation projects in mature organizations (Dougherty and Hardy 1996), financial success can take several years after market introduction (Sorescu et al. 2003), and many new product ideas eventually fail to be launched into the market (Barczak et al. 2009; Cooper 2001), we considered market introduction as an intermediate measure for effective really new product innovation. From this perspective, at least, eight of the ten projects under study could be considered successful at the start of our study.

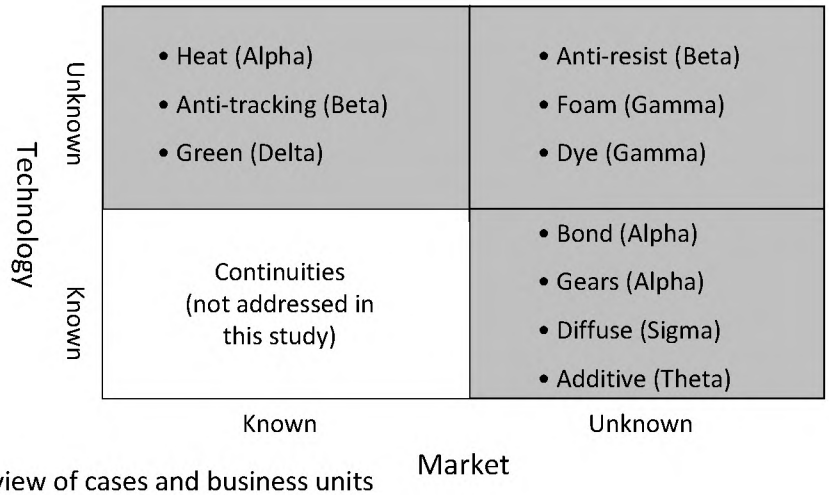


Figure 4.2: Overview of cases and business units

4.5 Data collection

Case studies can accommodate a rich variety of data sources such as interviews, archival data, and observations. If the research studies more than one case and phenomena under study are of strategic nature, as in the case of product innovation, interviews often become the primary data source of choice (Eisenhardt and Graeber 2007). This research is no exception. Data on really new product innovation projects and their interactions with the business unit in which they took place were mainly collected by interviewing key actors involved.

We used two semi-structured interview protocols to collect data (appendices A and B). The first protocol was used in interviews with multiple respondents that were knowledgeable about general aspects of the business units, such as its products, structure, innovation strategy, processes, and systems, but had limited involvement in day-to-day activities of the projects under study. The majority of these interviews were held with middle and upper management. Using multiple respondents provided the opportunity to mitigate potential biases of any individual respondent by allowing information to be confirmed across several sources (Goldon 1992; Huber and Power 1985). The second interview protocol was used to collect specific project data from informants that had been, or were still, active in day-to-day project activities. These interviews contained both general and more specific questions and were based on the conceptual framework that was presented in chapter three. The initial questions focused, as Pettigrew (1987) has suggested, on the content (what was it about) and the context (why did it come about) of the project which were followed by questions focused on the process (how did it take place). In most cases, a single question ('Could you please describe how the project developed over time?') was enough to trigger the main process story. After this initial story, we followed up with in-depth questions, focusing on specific dates, working practices, milestones, events, and outcomes. Similar to studies as Ancona and Caldwell (1992) and Danneels (2002), some accounts were retrospective and some were of current events. We interviewed multiple respondents with different functional backgrounds per project. This approach allowed for developing rich stories, since different respondents typically focus on complementary aspects of major decisions (Dougherty 1990). Since there was no list of people that

had been or were involved in the projects under study, the selection of respondents was based on information provided by other respondents. We finished data collection when additional data resulted in limited additional understanding (Eisenhardt 1989; Glaser and Strauss 1967; Lee 1999).

Table 4.2 provides an overview of the interviews. Both interview protocols allowed for expansion, illustration and digression. Respondents ranged from business managers to front-liners and the interviews lasted between 50 minutes and 2.5 hours. Sometimes notes were taken and all interviews were taped and transcribed verbatim, resulting in over 700 single spaced pages of transcript. We emphasized discussing facts, which are less subject to both cognitive biases and impression management (Huber and Power 1985; Miller et al. 1997). All interviews were held by the author personally and were followed up with clarifying e-mails and telephone calls when needed. Although most interviews were carried out on-site, six project interviews had to be held by telephone because key informants were located more than 500 kilometers away, which reflects the global nature of the industry. The author was in contact with respondents and had several site visits over a total period of, at least, one year, which allowed for tracking some project developments over time.

We supplemented interview data with internal and external archival data, such as new product proposals, product innovation protocols, product announcements, product catalogs, strategy overviews, annual reports, presentations, press releases, web pages, biographies, and business press articles, as much as possible, resulting in additional data of 120 pages per business unit and 90 pages per project on average.

Overall, the combination of two types of interviews and archival data collection enabled a rich understanding of the market learning in the projects and provided the opportunity for data triangulation (Jick 1979; Schwenk 1985), which counter-balances the weaknesses of one method with the strengths of another.

Table 4.2: Interviews of the research

Interviews Business Unit (Protocol I)			Interviews Project (Protocol II)		
Business unit	**Job title**	**Duration (min.)**	**Project**	**Job title**	**Duration (min.)**
Alpha	• Business Manager • VP Corporate Technology • R&D Manager • Global Marketing Manager	90 90 110 70	Heat (Alpha)	• General Product Manager • Application Development Manager • Product Developer	90 70 90
			Gears (Alpha)	• Business Development Manager • Senior Research Scientist	100 50
			Bond (Alpha)	• Application Development Manager • Business Development Manager • Business Development Manager	90 70 70
Beta	• Business Manager • Global Marketing Manager • Innovation Manager • Innovation Manager • R&D Manager	90 60 70 70 150	Anti-tracking (Beta)	• Technical Service and Development Manager • Sales Manager • Senior Research Scientist	90 70 90
			Anti-resist (Beta)	• Business Manager • Research Scientist • Project Manager	90 80 70
Gamma	• Global Marketing Director • General Manager Global Technology • Financial Analyst	135 110 70	Dye (Gamma)	• Marketing Project Manager • Technologist • Application Development Specialist	100 50 80
			Foam (Gamma)	• Industry Manager • Project Manager • Commercial Manager	100 60 60
Delta	• Technology Deployment Manager	80	Green (Delta)	• Business Manager • Business Development Manager • Research and Technical Manager	70 80 100
Sigma	• Head of New Business Development and Innovation • R&D Manager	100 90	Diffuse (Sigma)	• Head of Technology and Product Development • Product manager	120 80
Theta	• Manager New Markets	70	Additive (Theta)	• Business Manager • Key Account Development Manager • Senior Research Associate	80 130 100
Total	*16 respondents*	*1455*	*Total*	*28 respondents*	*2330*

4.6 Coding and analyzing data

When using case studies to build, extend, or integrate theory, often some overlap exists between studying existing theory, data collection, coding, and analysis (Burawoy 1991; Eisenhardt 1989). Literature provides conceptual frameworks to aid in the collection and interpretation of data, while data analysis can point to other relevant literature. While this 'controlled opportunism' is considered appropriate in order to take 'advantage of the uniqueness of a specific case and the emergence of new themes to improve resultant theory' (Eisenhardt 1989: 541), it can easily lead to data overload (Pettigrew 1990). In order to make sense of the data and avoid developing overly complex theory, we used several steps in coding and further analyses of the data (Eisenhardt 1989).

Coding

The first step in coding has been analyzing data from single cases. The aim was to get familiar with each case as a stand-alone entity. These analyses allowed for a unique case description. We thoroughly read transcripts and documents on the organizational context and the really new product innovation project and divided the information into meaningful fragments (Miles and Huberman 1994). These fragments were coded (i.e. labeled with a few words to indicate the meaning of the fragment)[22]. Initially, we coded fragments in two ways. First, when a fragment referred directly to a concept of the conceptual framework, such as 'senior management involvement' or 'market knowledge', it was coded as such. Second, new codes were developed when fragments did not fit the conceptual model, such as the 'the level of investment'. After this initial coding, we focused on each individual concept and developed more detailed codes, such as different types of 'senior management involvement'. Eventually our data could be captured by the set of concepts that we now briefly discuss.

The content of market learning (i.e. market knowledge) could be described as a multi-dimensional construct consisting of four dimensions: segment knowledge, product usage knowledge, application need knowledge, and customer knowledge. *Segment knowledge* refers to knowledge on market segment size, growth rate and turbulence, and stakeholders such as competitors, distributors, and regulating groups, which can influence customer behavior. *Product usage knowledge* refers to knowledge on how a product is used by customers and knowledge on how a product behaves in downstream manufacturing processes. For example, if an organization has a long history of selling a specific engineering plastic it probably has developed deep knowledge on how the product behaves in a variety of downstream manufacturing processes and what processing properties are specifically valued by customers. In contrast, if a new product is under development there is a limited product history and the organization has no product usage knowledge. It has to develop that knowledge by engaging in customer tests in the course of the product development trajectory. *Application need knowledge* is about knowledge on customer needs and wants a product should satisfy in specific applications and refers to specific application requirements. For example, if an organization has a long history of selling engineering plastics that are used in a specific vehicle part it probably has

[22] For coding and data handling we used the qualitative data analysis package NVivo.

developed deep knowledge about heat resistance and mechanical properties requirements for products used in this part. In contrast, if the downstream application is new to the firm it has limited knowledge on its requirements at the start of a product innovation trajectory. The organization has to develop that knowledge by discussions with (potential) customers and customer tests in the course of a product development trajectory. Product usage knowledge is distinct from application need knowledge. In a product development project, organizational members can target applications that are familiar to the firm (i.e. familiar application need knowledge) with a technology, or product, that is newly developed (i.e. unfamiliar product usage knowledge). In another product development project, in contrast, organizational members can use products or technologies that were already introduced in the market by means of earlier projects and target unfamiliar applications. Finally, *customer knowledge* does not refer to knowledge on customers needs and wants, but relates to additional knowledge related to customers, such as contact information, knowledge on the 'decision making unit' and knowledge on the innovation strategy of customers.

In this research, product usage knowledge, application need knowledge, and customer knowledge relates to business-to-business customers of chemical organizations such as downstream manufacturers. For instance, if product usage knowledge is mentioned this is about the usage of the chemical product by a downstream manufacturer. Table 4.3 presents and overview of the four market knowledge dimensions and the differences between exploitation and exploration on each dimension

Table 4.3: Market knowledge dimensions and the differences between exploitation and exploration

	Segment	**Product usage**	**Application need**	**Customer**
Answers the question	'What market segment is focused on?'	'What product/technology is used?'	'What applications are targeted?'	'What downstream parties are (potentially) buying?'
Exploitation in market learning	Market learning related to a market segment that is already defined by the firm	Market learning related to the deployment of firm products/technologies that are already used in the market	Market learning related to applications that are familiar to the firm	Market learning related to customer contacts that are familiar to the firm
Exploration in market learning	Market learning related to a newly defined market segment	Market learning related to the deployment of technology that is new to the firm and not used in the market	Market learning related to applications that are new to the firm	Market learning related to potential customers that are new to the firm

Next to distinguishing between four dimensions of market knowledge, based on our empirical data we could also further detail the four concepts of ambidextrous marketing organizations (i.e. marketing function, senior management involvement, market knowledge generation and market knowledge integration). This refinement is briefly presented in table 4.4.

Table 4.4: Refinement of the concepts of the ambidextrous marketing organization

Concept	Description
Marketing function	
• specialist(s)	Organizational employee(s) that perform(s) the marketing function is/are specialized in the sense that establishing an interface with the market is part of his/her/their formal job description.
• Low task focus	The marketing function as a whole is highly integrated in the mainstream organization.
• High task focus	The marketing function as a whole is less integrated in the mainstream organization.
Senior management involvement	
• Directing	Results directly from the organization's innovation strategy and relates to initiating the generation and integrating of market knowledge at the start of a product innovation project. It refers to senior managers giving concrete assignments to employees at a lower hierarchical level to update market knowledge on specific dimensions.
• Framing	Results directly from the organization's innovation strategy and relates to initiating the generation and integration of market knowledge at the start of a product innovation project. When framing, senior management does not give concrete assignments but articulates a, less specific, strategic direction that can trigger the generation and integration of market knowledge. Framing is the articulation of the business unit's vision of what it wants to achieve beyond the near future.
• Supporting	Refers to the allocation of human and financial resources to carry out necessary market analyses and acting as sounding board for project members in the development and commercialization phases of the product development project.
• Controlling	Refers to tracking progress in market analyses, detecting deviations from original plans, and taking action when it is deemed necessary.
Market knowledge generation	
• Market scanning	Generating marketing knowledge in the initiation phase of a product development project by using desk research in combination with visiting conferences or trade-fairs and/or visiting existing customers.
• Collaborating with customers	Generating market knowledge in the development and commercialization phases of a product development project by collaborating with customers to test and discuss prototypes.
• Using framework	Structuring market knowledge generation in the initiation phase by using a formalized 'market assessment' process that supports project members with market mapping and segmentation tools to collect and interpret new market information.
• Hiring segment specialist(s)	Hiring (a) new employee(s) in the development and commercialization phases that has/ have extensive knowledge on the market segment that the firm is entering by carrying out the product innovation project.
Market knowledge integration	
• Using the hierarchy of authority	Senior managers collect market knowledge, including the knowledge that is generated by employees that are acting on a lower hierarchical level, and other relevant product innovation knowledge in the initiation phase of a project, and integrate it by developing the business plan.
• Using internal organizational network	Employees acting on a relatively low hierarchical level use their internal organizational network to integrate market knowledge with other relevant product innovation knowledge in the initiation phase of a project.
• Having recurrent team meetings	Recurrent meetings between project members with different functional backgrounds to discuss progress and insights, and synchronize work in the development and commercialization phases of a project.
• Discussing prototypes	Project members from different functional backgrounds discuss prototypes in the development and commercialization phases of a project.
• Using cross-functional implementation framework	Project members from different functional backgrounds use a cross-functional implementation framework, such as a Stage-Gate methodology, in the development and commercialization phases of a project.

Further analyses

During coding we generated preliminary notes of insights that emerged on relationships between concepts and a chronological case description was made per case. This description was fed back for review by several respondents. In addition, we collaborated with two additional researchers that worked in the same research group but had only limited involvement in the research project. Based on the interview data and some working definitions of emerging constructs we asked each of the two researchers to develop a schematic description of one case. Resulting differences in perspective were discussed among the total group of researchers until consensus was reached.

The cases were then compared with each other. The rationale behind this step is that cross-case searching tactics force researchers to move beyond initial impressions (Eisenhardt 1989). We focused on similarities and differences between cases within separate project categories and compared them with cases from other categories. Significant discrepancies and agreements were noted and further investigated.

Based on the analytical steps described above, we refined the initial conceptual framework. To further sharpen this framework and test its validity, it was systematically compared with evidence from each case and with existing literature (Eisenhardt 1989). Iterating back and forward between theory, the refined conceptual framework, and data resulted in the final set of organizational configurations to resolve the market learning paradox in the course of really new product development projects.

4.7 Presentation of findings

The challenge in presenting multiple case study research is to stay within spatial constraints while simultaneously conveying both the emergent theory and the empirical evidence supporting it (Eisenhardt and Graebner 2007). The tactic that is used in this research is to present the theory in sections. The following three chapters will provide descriptions and analyses of all individual cases. Each of these chapters presents the cases of a specific really new product category. Thus, we deliberately will present the findings in such a way that they provide the most insight into the separate cases. As a consequence, a general description of a specific business unit in which a project took place will sometimes be presented in two chapters. For example, projects Heat and Gears were both carried out in business unit Alpha but will be discussed in two separate chapters. Accordingly, the general characteristics of Alpha will also be described in these two chapters.

Each chapter will describe three or four cases. Each case description will start with a general overview of the project and the business unit in which it was carried out. Subsequently, the description follows the framework that was presented in chapter three. We will focus attention and present evidence on how market learning took place during the product innovation trajectory and how the four elements of the organizational configuration were put into practice. We will also describe the nature of additional concepts if these emerged during data analyses. Each chapter will conclude with an overall comparison of projects from a specific project category.

Next to individual case descriptions, a cross-case comparison will be presented in an additional chapter. This chapter is crafted around the concepts of the revised conceptual framework. Since

multiple-case study research only retains relationships that are replicated among a significant number of cases, cross-case comparisons are often less detailed than single case descriptions (Eisenhardt and Graebner 2007). This research is no exception. The cross-case comparison that will be presented in the additional chapter is more parsimonious than the individual case descriptions. However, because it is based on insights that were found across cases, it is more robust.

4.8 Rigor of the research

Scandura and Williams (2000: 1263) have reminded us that: 'without rigor, relevance in management research can not be claimed'. In the following section we will discuss how we undertook enhancing the rigor of our research.

Four criteria are commonly used to assess the rigor of field research (Campbell 1975; Gibbert et al. 2008): internal validity, construct validity, external validity, and reliability. *Internal validity* refers to the causal relationships between variables. The issue at stake is whether the researcher provides a powerful and compelling causal argument. *Construct validity* refers to the quality of the operationalization of relevant concepts. As such, it focuses on the extent to which a study investigates what it claims to investigate. *External validity* is about the generalizability of the study[23]. This criterion is grounded in the belief that theories must be shown to account for phenomena not only in the setting in which they are studied, but also in other settings. Finally, *reliability* refers to the absence of random error, enabling other researchers to arrive at the same results if they conduct the research along the same steps. It should be emphasized that the three validity criteria are not independent of each other. As Gibbert and colleagues (2008: 1468) state: 'without a clear theoretical and causal logic (internal validity), and without a careful link between the theoretical conjecture and the empirical observations (construct validity), there can be no external validity in the first place'.

Several researchers have provided measures for meeting these criteria in case study research (Eisenhardt 1989; Yin 1994; Eisenhardt and Graeber 2007; Gibbert et al. 2008). Table 4.3 presents the measures that we took to meet the criteria mentioned above.

[23] Neither single nor multiple case studies allow for statistical generalization (Numagami 1998; Yin 1994). This does not mean, however, that case studies are devoid to generalization. Instead of statistical generalization, which generalizes from empirical observations to a population, case studies should be subject to analytical generalization, which generalizes from empirical observations to theory (Yin 1994).

Table 4.5: Measures to enhance case study rigor

Criteria	Measures	Research phase
Internal validity	Conceptual framework with relationships explicitly derived from literature (Gibbert et al. 2008)	Design
	Pattern matching of cases within and between product innovation categories and with existing theory (Yin 1994; Eisenhardt 1989; Gibbert et al. 2008)	Data analyses
	Explanation of differences between patterns (Yin 1994)	Data analyses
Construct validity	Conceptual framework as *a priori* specification of concepts (Eisenhardt 1989)	Design
	Triangulation through multiple sources of evidence, and multiple informants per case (Yin 1994; Eisenhardt and Graebner 2007; Gibbert et al. 2008)	Data collection
	Description of data collection circumstances (Gibbert et al. 2008)	Data collection
	Reviews by key informants and peers (Yin 1994; Gibbert et al. 2008)	Data analyses
External validity	Selection of multiple cases based on theoretical rationale (Eisenhardt 1989; Gibbert et al. 2008)	Design
	Details on research setting (Gibbert et al. 2008)	Design
Reliability	Development and documentation of interview protocols (Yin 1994; Gibbert et al. 2008)	Design
	Developing a case study database with all available protocols, interview transcripts, archival data and notes (Yin 1994; Gibbert et al. 2008)	Data collection / analyses

A significant level of internal validity was reached by developing an initial conceptual framework that was derived from existing theory and presented causal relationships. Additionally, we compared the causal relationships that were found with other cases from the same product innovation category and with cases from other categories and successfully attributed differences to several concepts. We dealt with construct validity by *a priori* specification of potentially important concepts based on existing literature, including multiple sources of evidence (interviews and archival data) and multiple informants per case, providing a description on how we collected data, and allowing for reviews by key informants and peers. Enhancing external validity (i.e. analytical generalization) was achieved by a theoretically based selection of cases, and discussing the chemical industry as research setting. Finally, a significant level of reliability was reached by developing and documenting interview protocols, and developing a case study database.

4.9 Summary

This chapter discussed the research strategy and the outline of the empirical study. This research adopted a multiple case study strategy to re-conceptualize and refine theory on market oriented

product innovation. Empirical data were collected in the research setting of the chemical industry. Although this study investigated the interaction between market learning and organizational configurations, the product innovation project served as main unit of analysis. Ten projects from three really new product innovation categories were researched. These projects were carried out in six business units of six different multinational chemical firms. Data were mainly collected by using in-depth semi-structured interviews with key informants. Main steps in data analyses were a single case analysis, a comparison of findings between different cases in the same category, and a comparison of findings between cases from different categories. These steps will also be used to present findings. Finally, the chapter described the measures that were taken to enhance the rigor of the research.

5 Tech-discontinuities: Heat, Anti-tracking, and Green

This chapter describes the findings on cases that fall into the 'tech-discontinuities' project category. These projects are based on product technology and/or process technology that is unknown, or new, to the organizations in which they are carried out and are focused on application markets that are already known to the firm[24]. Successively, the chapter presents the findings on cases 'Heat' (Alpha), 'Anti-tracking' (Beta), and 'Green' (Delta). Case descriptions are structured around the concepts that were presented in the conceptual framework in chapter 3. The chapter is concluded with an overall comparison.

5.1 Heat (Alpha)

Alpha is a business unit of a multinational chemical company and a global player in the engineering plastics industry. Important end markets of Alpha's products are the automotive, electrical and electronics (E&E), and the packaging industries. Companies in these end markets use Alpha's materials to fabricate their own products which they sell to the general public. In 2008, the business unit had around 760 million Euros in annual sales and employed about 1,650 people (table 5.1).

Table 5.1: Key numerical data Alpha 2002-2008 (based on annual reports)

Alpha	2002	2003	2004	2005	2006	2007	2008
Sales (mln. Euro)	579	566	624	705	735	807	761
EBIT (operating profit)	36	29	46	87	118	98	58
EBIT/sales ratio (%)	6.2	5.1	7.4	12.3	16.1	12.1	7.6
Employees	1,190	1,204	1,158	1,273	1,242	1,462	1,649
R&D expenses (mln. Euro)	26	26	24	27	31	38	42
R&D/sales ratio (%)	4.5	4.6	3.8	3.8	4.2	4.7	5.5

Alpha has a matrix organization. The main activities are divided into three regions and four global product lines. Each product line has a business manager and three regional product managers. The product lines have their own R&D. Additionally, there are regional development and sales teams that focus on important multi-product end-markets such as automotive and E&E. Figure 5.1 presents a simplified organizational chart. Recently, Alpha has introduced a new product: *Heat*.

[24] In all cases in this chapter, the underlying technology is not only new to the firm but also 'new to the world'. In the terminology of Garcia and Calantone (2002) these are product innovation projects with a 'macro-level' technology discontinuity. Hence, the tech-discontinuity category does not involve cases in which an organization bought or licensed-in a particular product and/or process technology.

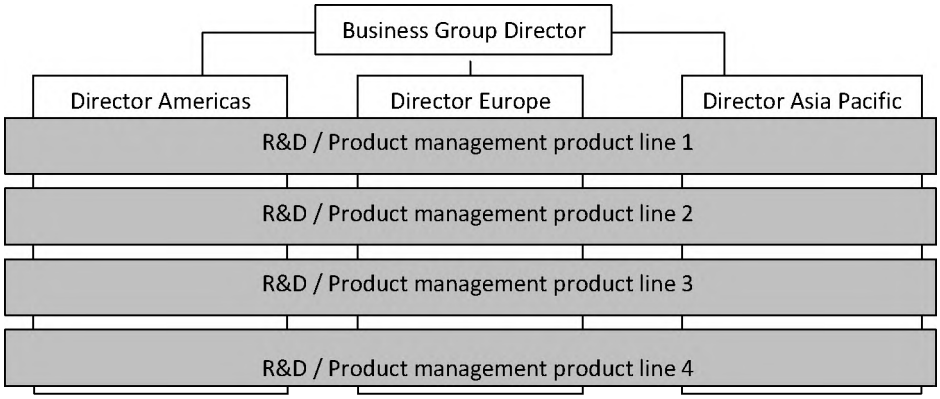


Figure 5.1: Simplified organizational chart Alpha (based on interviews and Alpha's website)

General outline of project Heat

Project *Heat* was carried out in one of Alpha's four globally operating product lines. Among other applications, the plastic of this product line is used in engine components of vehicles, so-called 'under the bonnet' (UTB) applications. As a project, *Heat* was developed in Europe and required a medium level of investment. Significant technological research had to take place but the new product could be manufactured in existing plants. The project fits the 'tech-discontinuities' category because new technology was used to target familiar market applications.

In 2003, it was recognized by the product line that their general grade of plastic would not meet future (5+ years) heat resistance requirements of UTB applications. The need for efficient combustion in engines, driven by EURO 5 and EURO 6 regulations, would result in engine designs with higher operating temperatures. At these temperatures the general grade would melt. At the same time, an ongoing research program to build fundamental knowledge on failure mechanisms of their plastic under high heat reached a technical breakthrough. This research program was a joint effort of Alpha's R&D department and the corporate research organization of the chemical multinational. The product line *initiated* a number of small research assignments to develop a perspective on how long it would take to develop a new grade of plastic based on this breakthrough. Based on these research assignments, the European product manager decided to write an official product development proposal. This request was approved by the product development leadership counsel of the product line in 2005, which started a more formalized plastic grade *development* trajectory. The grade development trajectory consisted of several rounds of technical testing and dealing with issues of manufacturability. The grade development trajectory brought the number of polymer recipes down from about 25 to two. In June 2006, Alpha managed to develop collaborations with several engine part producers and two European automotive OEMs[25]. From that point onwards, Alpha had to achieve several technical approvals at the OEMs for which it had intensive contacts with its development partners. From 2007 onwards, achieving technical approvals was accompanied by achieving *commercial* approvals. In 2008 the new grade of high temperature plastic was nominated

[25] OEM = Original Equipment Manufacturer. In the context of the automotive industry, OEMs are, for instance, Volkswagen and Renault.

to be used in a next generation vehicle program which was introduced in October that year. At that time, several new technical approval trajectories with other OEMs had already started.

In general, Alpha regards project *Heat* as a successful project. The new product could be introduced into the market and generated spin-off projects. It was developed in a relatively short period of time and spending was only a bit more than budgeted. Table 5.2 presents Heat's key characteristics with the corresponding case study evidence.

Table 5.2: Key characteristics Heat

Characteristics	**Case study evidence**
Project category: *Tech-discontinuity*	'…first member of the next generation family of grades.' *press release* 'The project involves a new underlying chemistry' *Product manager* 'Let's say, (Heat *ed.*) is really a new grade, a new type of material for existing applications… (Heat *ed.*) is the fruit of our research people' *Marketing manager* 'In this project we commercialized a technical breakthrough' *Product developer*
Investment level: *Medium*	'….the production, polymerization and compounding, does not change' *Product manager* 'The basic polymer stays the same. Otherwise you have to build a new factory. That's really big money' *Business manager* 'We had to invest a significant amount of money to develop the product' *Product developer*

Market learning

Project *Heat* was focused on a market segment (automotive UTB), applications (turbo-charger and air/fuel system components) and customers (engine part producers and automotive OEMs) that were already known to Alpha. Consequently, it already had significant market knowledge on these dimensions at the start of the project. In contrast, because the grade of plastic was new to the market, Alpha had limited product usage knowledge. It had to learn about product usage by exploratory probes of different prototypes in the market during the development and commercialization phases of the project.

Exploration and exploitation in market learning were combined across market knowledge dimensions in the development phase, and over time. Sufficient market knowledge was generated and market knowledge integration occurred without any considerable problems (table 5.3).

Table 5.3: Market learning Heat

(phase) Knowledge dimension	(period) Learning Type	Case study evidence
(Initiation)	('03-'05)	
Segment	Exploitation	'(Alpha's *ed.*) products are used for over 10 years in this segment' *Alpha's website* '...(Heat *ed.*) was born from studying market trends' *Product manager* 'We learned that temperature requirements were going up due to governmental regulations' *Product developer*
Application	Exploitation	'We already have running business in these applications...' *Product manager* 'We identified the market trend and asked our application developers to visit OEMs to identify future application requirements' *Product manager* 'When you develop that engine part out of several pieces you get weld lines that break at a certain temperature' *Product developer*
Customer	Exploitation	'Account-managers were already in contact with OEMs...' *Product manager* 'We already know all 10 tier 1 automotive suppliers in this segment' *Marketing manager* 'We identified the market trend and asked our application developers to visit OEMs to identify future application requirements' *Product manager*
(Developm.)	('05-'07)	
Application	Exploitation	'The OEMs also did application tests. These results were shared with us' *Product manager*
Product	*Exploration*	'Because we only did internal testing with the new grade, we really needed these real-life product tests to validate our remaining recipes' *Product manager*
Customer	Exploitation	'We know who is most important in this market segment, so internally we selected a set of potential partners. Then we tried to convince these customers to work with us on this project' *App. development manager* 'The further we went (in the product innovation trajectory *ed.*) the more we did with the customer' *Business manager*
(Commerc.)	('07-'08)	
Application	Exploitation	'Later we had to achieve commercial approvals for the new product in certain applications at OEMs....' *Product manger*
Product	Exploitation	'In 2008 we received the first approval from an automotive OEM. Our new material is used next to the existing material' *Product developer*
Customer	Exploitation	'In 2008 we were trying to get commercial approvals with (automotive OEM *ed.*). That worked out well, and they are going to use this new product in a small engine part' *App. development manager*

Marketing function

The central role in the market learning within project *Heat* was in the hands of European application development of the product line (R&D). Application developers were marketing specialists in the sense that interacting with customers on technical issues was part of their official task description. This function was supported in its market learning efforts by European product management in the project's initiation phase.

The task focus of the application developers involved in project *Heat* was relatively low. They were involved in both exploration and exploitation and had other task next to project *Heat* such as developing incremental updates of existing products and answering customer questions. In other word, these application developers were highly integrated in the mainstream organization (Table 5.4).

Table 5.4: Marketing function Heat

(phase; period) Marketing function	Case study evidence
(Initiation '03-'05) Application development / Product management	'Product management and global marketing is great to think about segment trends and their quantification.....application development focuses on specific application needs of customers' *Marketing manager* 'We (product management *ed.*) had recognized a market trend and we asked the application developers to visit automotive OEMs to generate application requirements' *Product manager* 'We are connected to the market via (application development manager *ed.*)' *Product developer* 'Besides this project I am also responsible for answering general customer questions that fall within the automotive UTB segment' *App. development manager*
(Developm. and commercialization '05-'08) Application development	'Application developers talked with project members of the customer.....they talked about the test results of testing prototypes' *Product manager* 'Application developers.....have multiple responsibilities next to this project. That is why it is important to keep track on priorities' *Product manager*

Senior management involvement

Several senior managers of Alpha were involved in the market learning of project *Heat*. They were present in the Global Product Team which consists of the business manager, the global marketing manager, the R&D manager and the product managers of the product line. During initiation, specifically the European product manager directed updating application need and customer knowledge based on an initial update of his own segment knowledge which provided an impetus to start project *Heat*. During development and commercialization, senior managers employed a mixture of support and control. Support concerned facilitating project members by means of resources and freedom to be active in the day-to-day market learning activities of this rather uncertain project. Control referred to tracking progress in market analyses, detecting deviations from original plans, and taking action when it was deemed necessary (table 5.5).

Table 5.5: Senior management involvement Heat

(phase; period) Senior management involvement	Case study evidence
(Initiation '03-'05) Directing	'I asked our application developers to collect future application requirements' *Product manager* 'Before we started this project, it was quite clear in our product line that we would encounter future shortcomings with our current product. Therefore the initiation of this project came from all sides. The actual decision to collect future product needs was directed by the Global Product Team' *App. development manager* 'One of our strategic focus points is to adapt our current products for future market requirements. This implies that you need some level of pro-activeness' *Product developer*
(Developm. and commercialization '05-'08) Support / Control	'For important projects, like this one, we have monthly review meetings... to see if we are on track, if we need to adjust the plan' *Product manager* 'Project members have a full mandate within certain boundaries' *Product manager* 'For developing the product, we received a significant amount of freedom from senior management' *Product developer* 'If you put the application developers and the technologists of the customers together you have good collaboration and they can fine-tune forever. Therefore there is my role to keep a focused discussion that is driven by business goals' *Product manager* '...my product managers are responsible for steering the innovation process'. *Business manager*

Market knowledge generation

For project *Heat*, market knowledge was mainly generated by desk research and visiting conferences (segment knowledge), and visiting existing customers (application need knowledge, and customer knowledge) during the initiation phase. In the development and commercialization phases, market knowledge generation (application needs knowledge, product usage knowledge, and customer knowledge) took place by testing prototypes in collaboration with direct and indirect customers (table 5.6).

Table 5.6: Market knowledge generation Heat

(phase; period) Market knowledge generation	Case study evidence
(Initiation '03-'05) Desk research / Conferences / Customers contacts	'I visited conferences and industry meetings where the automotive world presents future ideas on an ongoing basis.....these visits, combined with studying trend reports, were important sources of information' *Product manager* 'I talked to customers to uncover specific application requirements which were used to develop the product development proposal' *App. development manager*
(Developm. and commercialization '05-'08) Collaboration with customers	'We were able to use our development partners to get market feedback during development' *Product manager* '....we had a really good collaboration when we tested prototypes. We had contact with them every 1.5 months' *Product manager* '...we worked intensively together with several automotive OEM's and tier 1 automotive suppliers to test prototypes and explain our new product' *App. development manager*

Market knowledge integration

For project *Heat*, market knowledge integration in the initiation phase was carried out through the hierarchy of authority. The European product manager had a main stake in developing the business case based on his own (updated) segment knowledge and knowledge from application development managers and other functional specialists such as researchers. During development and commercialization, employees made use of recurrent face-to-face meetings involving multiple functions. They also used discussing prototypes to cross cognitive boundaries between different functional specialists. Finally, the use of an organization-wide used cross-functional project implementation framework (i.e. PTO tool), which brought common language and awareness of different responsibilities across the team, also supported market knowledge integration (table 5.7).

Table 5.7: Market knowledge integration Heat

(phase; period) Market knowledge integration	**Case study evidence**
(Initiation '03-'05) Hierarchy of authority	'...I collected all information from different functional specialists and wrote the product development proposal' *Product manager*
(Developm. and commercialization '05-'08) Recurrent meetings / Prototypes / Implementation framework	'(In this project *ed.*) coordination between different functionalities when developing the new product took place by having recurrent meetings' *App. development manager* 'We had multifunctional review meetings to discuss project issues' *Product manager* 'In development, we discussed prototypes. We went from 25 recipes to 15, to 5, and eventually we tested two recipes with the customer....' *Product manager* 'Every six weeks we had very constructive meetings involving research and marketing to discuss project progress' *Product manager* 'When we started working together with customers we recorded that in the PTO tool, which is used in discussions on project progress and setting priorities' *App. development manager*

5.2 Anti-tracking (Beta)

Beta is a business unit of a multinational chemical company. It manufactures and sells a high performance fiber in product forms such as powder, pulp and filament yarn. Important end markets are automotive and defense industries. Companies in these end markets use Beta's materials to fabricate their own products which are sold to other companies, governments and the general public. Beta has offices and sales agents all over the world. In 2007, the business unit had several 100 million Euros in annual sales and employed about 1,000 people (table 5.8).

Table 5.8: Key numerical data Beta 2002-2007 (indices, 2002 = 100; based on annual reports)

Beta	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Sales	100	124	145	158	173	181
Employees	100	107	110	115	125	130
R&D expenses	100	117	125	133	150	133

For application development and sales, Beta has organized eight globally operating sales/ marketing groups. Each of these groups targets a specific market segment with a set of product

forms. Additionally, Beta has its own research department. Recently, the organization has set up a small marketing support function to develop and support cross-group marketing initiatives and innovation. Figure 5.2 presents a simplified organizational chart. At this moment, Beta aims to introduce a new product: *Anti-tracking*.

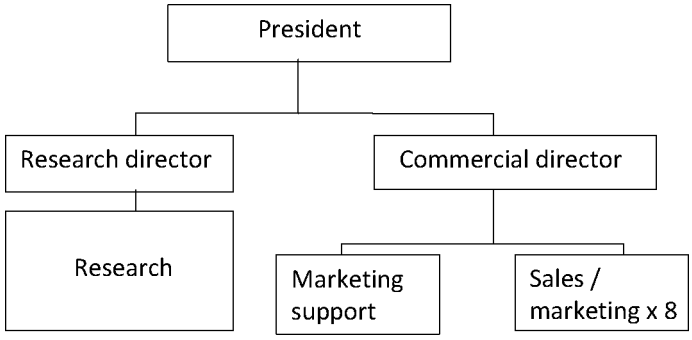


Figure 5.2: Simplified organizational chart Beta (based on interviews and Beta's website)

General outline of project Anti-tracking

Project *Anti-tracking* was mainly carried out by the research department and one of the eight sales/ marketing groups of Beta. This sales/marketing group focuses on the fiber optic cables segment (i.e. communication cables), where Beta's yarn is sold as reinforcement material. As a project, Anti-tracking was developed in Europe and required a medium level of investment. Research had to take place but no major plant adaptations were necessary because Beta decided to work with an external converter for manufacturing purposes. The project fits the 'tech-discontinuities' category because new technology was used to target a familiar market application.

In a specific type of fiber optic cables, which can be installed by using an existing high voltage power pylon infrastructure, the following problem may occur. Installation alongside high voltage power lines results in electromagnetic fields that can give rise to significant voltage gradients along the length of the cables. If the surface of the cable becomes partly dry and partly wet because of sunshine and moisture, these gradients can induce a current along the cable. Over time, these currents, which produce sparks, can leave tracks that damage the cables (i.e. dry band arcing) and disturb the transmitted signals. A customer of Beta (a cable producer with leading technology), had solved the dry band arcing problem by, among other things, impregnating Beta's yarn[26] with a semi-conductive gel which is bought from a third party. This gel reduced the currents with 30%, which significantly increased the lifetime of the cables. However, Beta's customer thought it could further improve the situation when Beta applied the gel in an additional manufacturing step. Both parties already talked about this issue at the end of the nineties but these talks did not lead to a collaborative project. In 2002, both parties found the time to look into this issue again, which resulted in the *initiation* of the *Anti-tracking* project. Based on the gel provided by Beta's customer, Beta's research department was able to come up with an own material. Instead of gel-based, this

[26] Beta's yarn is used as reinforcement material and lies in between the cable outer sheath material and the optic fibers.

material was oil-based and therefore better applicable. The *development* phase started when Beta's customer tested cables with the oil-based product on lab scale together with a German university in 2005. After some iterative testing, results were promising and Beta produced a batch of anti-tracking yarn together with a German converter who applied the oil to the yarn. This yarn was used by Beta's customer to manufacture several kilometers of cable, which happened without any significant problems. In November 2006, Beta and its customer jointly presented a paper on these developments at an industry conference. The cable world, however, was not that impressed because the majority of cable producers already used a solution that was well accepted by their customers, the network operators. It appeared to Beta, that their proposed launching customer had relatively higher cable requirements than the average cable producer. In April 2007, the organization that owned Beta's customer sold this business unit to another cable producer. This party had other priorities and decided not to promote the anti-tracking development. Beta focuses on continuing developments with other cable producers and has started a market research project to develop insights on the fiber optic cable value chain together with a consultant. In 2008, the project was still in the development phase.

In general, Beta regards project *Anti-tracking* as a technical success. However, commercial success is still lacking. This mainly had to do with focusing on one customer and the change in this customer's situation in 2007. Table 5.9 presents the project's key characteristics with the corresponding case study evidence.

Table 5.9: Key characteristics Anti-tracking

Characteristics	Case study evidence
Project category: *Tech-discontinuity*	A patent application for the Anti-tracking yarn was filed in June 2007 *Patent application* 'Delivering yarn with a bit of finish for this segment is standard, but focusing on semi-conductivity is new. We never did that and therefore this is a new product' *Researcher*
Investment level: *Medium*	'This project was not done under a specific work order.... despite the fact that it was reasonably large..' *Application developer* 'We did not know how much we should sell. If you don't have a good answer to that question, the company is not going to invest in a new production facility. Therefore we used an external converter in this project....You first have to prove yourself' *Researcher* 'We also had to invest money in the cable tests at (German university *ed.*), which was a significant sum for our marketing/sales group' *Sales manager*

Market learning

Project *Anti-tracking* was focused on a market segment (fiber optic cables), applications (a specific type of cable) and customers (cable producers) that were already known to Beta. Consequently, it already had significant market knowledge on these dimensions at the start of the project. In contrast, because the product was new to the market, Beta had limited product usage knowledge. It had to generate this knowledge by exploratory probes of initial versions of the anti-tracking yarn in the market during the development phase.

Until 2008, exploration and exploitation in market learning were combined across market knowledge dimensions in the development phase. Beta did not update segment knowledge during project initiation which resulted in a commercialization problem. It tried to address that in the

development phase by working together with a consultant. The integration of market knowledge on the remaining dimensions with other relevant knowledge occurred without any considerable problems (table 5.10).

Table 5.10: Market learning Anti-tracking

(phase) Knowledge dimension	**(period) Learning Type**	**Case study evidence**
(Initiation)	('02-'05)	
Application	Exploitation	'...we already make yarn which is used as reinforcement in this type of cables' *Application developer* '..we measured the electrical conductivity of their cables and used this measure as research target' *Researcher*
Customer	Exploitation	'We have a long history in this market segment and know most of the players...' *Application developer* 'This project is focused on an existing customer of Beta' *Researcher* 'We had meetings with this customer and agreed upon a joint project' *Application developer* 'We visited them (the customer *ed.*) several times' *Sales manager*
(Developm.)	('05-'08)	
Segment	Exploitation	'Beta is active in this market segment since it emerged, some two decades ago' *Beta's website* Together with *(*consultant *ed.)* we are further researching the segment, specifically focusing on network operators' *Application developer*
Application	Exploitation	'...the customer made cables at lab-scale and production scale and we received feedback' *Application developer* '...we saw how they made the cables' *Researcher* '...we increased our knowledge on the dry band arcing problem' *Sales manager*
Product	*Exploration*	'Until then, the recipes were made in our lab.....we never had put so much oil on our yarn so there were tests in the customer's plant to see if they could work with it' *Application developer* 'We had to test our initial recipes at the customer, who made cables with our impregnated yarn' '...we wanted to do a field-test to see if it worked in practice....This is also crucial to develop credibility in the market' *Researcher*
Customer	Exploitation	'Cables were tested at the customer' *Researcher* 'Cables were tested at the customer....we physically went there' *Application developer* 'The new owner of our customer had other priorities...' *Sales manager* 'I also talked to the researchers and purchasers at (customer ed.)' *Sales manager*

Marketing function

The central role in the market learning of project *Anti-tracking* was in the hands of the sales manager of the fiber optic cables sales/marketing group. In this function, he was supported by an application developer who works in the same group. Both functions were marketing specialists in a sense that interacting with customers was part of their official task description.

The task focus of the marketing function involved in project *Anti-tracking* was relatively low. They were involved in both exploration and exploitation and had other tasks next to this project, such as

supporting the running business by selling and answering customer questions. In other words, the marketing function was highly integrated in the mainstream organization (table 5.11).

Table 5.11: Marketing function Anti-tracking

(phase; period) Marketing function	Case study evidence
(Initiation '02-'05) Sales / Application development	'I am responsible for the fiber optics segment.....have sales responsibility and do pricing and contracts.....and new products with customers' *Sales manager* 'I joined my sales colleague when he visited the customer' *Application developer*
(Developm. '05-'08) Sales / Application development	'We (sales/marketing group *ed.*) visited the customer to be present when prototype testing took place' *Application developer* 'The (sales/marketing group *ed.*) is my middleman...test results and feedback passes through them' *Researcher*

Senior management involvement

Specifically two senior managers of Beta were involved in the market learning that took place in project *Anti-tracking*: the research director, who was part of the management team, and the sales/marketing group manager.

Most of the work for project *Anti-tracking* was carried out by using general research and sales support resources. Although the research department and the sales/marketing group had to report to the research director how these resources were spent, he had limited involvement in controlling them. The sales/marketing group manager had a stake in initiating the project. Because the sales manager had just taken up this job and had to settle in, the group manager suggested starting new conversations with Beta's customer on the dry band arcing problem. Additionally, in the development phase, extra investments were needed to carry out the tests at the German university. These investments needed specific approval by the research director. Based on a rough estimation of the total available market, approval was received (table 5.12).

Table 5.12: Senior management involvement Anti-tracking

(phase; period) Senior management involvement	Case study evidence
(Initiation '02-'05) Directing	'...conversations on this subject with the customer were dead at that time (2002 *ed.*).....because I was new in the group, our (sales/marketing group ed.) manager asked me to pick up the conversations again...' *Sales manager*
(Developm. '05-'08) Support / (Limited) control	'...we could work within the budget that was set aside for general sales support' *Sales manager'* '....I worked on this project within the general budget reservations for 'finishes for cables'.....which is discussed with the research director once per year' *Researcher* '...we provide the management team (the directors *ed.*) with quarterly reports' *Researcher* '...research provides quarterly reports and I write these on a monthly basis....based on these data, the management team did not stop me...' *Application developer* 'Costs for the test at (university *ed.*) were relatively high. The research director had to sign a separate request before we received these resources' *Sales manager*

Market knowledge generation

During the initiation phase, application need and customer knowledge for project *Anti-tracking* was generated by customer visits. In the development phase Beta collaborated with a customer for testing purposes, which generated product usage, application need, and customer knowledge. In this phase Beta also worked together with a consultant to generate segment knowledge (table 5.13).

Table 5.13: Market knowledge generation Anti-tracking

(phase; period) Market knowledge generation	**Case study evidence**
(Initiation '02-'05) Customer contact	' We had meetings with this customer and agreed upon a joint project' *Application developer* 'We visited them (the customer *ed.*) several times' *Sales manager*
(Developm. '05-'08) Collaboration with customer / Working with consultant	'...together with (customer *ed.*) we tested our product....first on lab-scale, and later in a manufacturing environment' *Application developer* '...we had a very open communication with (customer *ed.*)' *Researcher* 'We worked together with (*consultant ed.*) to develop a perspective on how to position our product and convince network operators' *Application developer*

Market knowledge integration

For project *Anti-tracking*, market knowledge integration in the initiation phase was mainly carried out by functional specialists using their internal organizational network. During the development phase, functional specialists had recurrent meetings and discussed prototypes. The sales manager and application developer worked in the same building. Although the researcher operated from another building, he was located in the same city (table 5.14).

Table 5.14: Market knowledge integration Anti-tracking

(phase; period) Market knowledge integration	**Case study evidence**
(Initiation '02-'05) Internal organizational network	'I have contact with the (sales/marketing group *ed*).....they approached me to think about solving the dry band arcing problem from a 'yarn finishing' perspective' *Researcher*
(Developm. '05-'08) Recurrent meetings / Prototypes	'..we had meetings with research for information sharing when something came up. However, these were not structured as in project meetings, but rather ad hoc' *Sales manager* '..in house, we developed several versions of the product' *Researcher* '...We (research and marketing/sales group *ed.*) discussed several product versions' *Application developer*

5.3 Green (Delta)

Delta operates as a business unit of a multinational chemical company that is active in the fields of engineering plastics and chemicals. Delta is a global player in chemicals but has a main focus on Europe. Important end markets for Delta's products are the pulp and paper and the chemical industries. Companies in these markets use Delta's chemicals to fabricate or process their own

products which they sell to downstream companies and the general public. For some products, Delta is one of the market leaders, for other products it is a smaller player. The organization has the most commoditized product portfolio of all participating businesses in this research, hence the relatively low R&D/sales ratio. In 2008, the business unit had around 800 million Euros in annual sales and employed about 2,300 people (table 5.15).

Table 5.15: Key numerical data Delta 2002-2008 (based on annual reports)

Delta	2003	2004	2005	2006	2007	2008
Sales (mln. Euro)	526	535	613	659	727	805
EBIT (operating profit)	40	40	63	69	81	62
EBIT/sales ratio (%)	7.6	7.5	10.3	10.5	11.1	7.7
Employees	2,024	1,891	1,919	1,912	2,015	2,331
R&D expenses (mln. Euro)	7	6	6	7	9	10
R&D/sales ratio (%)	1.3	1.1	1.0	1.1	1.2	1.2

Delta is subdivided into two businesses based on differences in product offerings. Both businesses have a global scope and a department that is responsible for the combined task of sales and marketing. Although the core of sales and marketing activities lies in Europe, sales/marketing managers are located around the globe. Delta has a separate R&D department that works for both businesses (figure 5.3). Recently, Delta has been working on project *Green*.

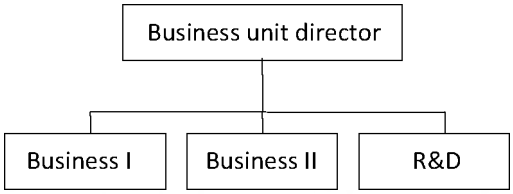


Figure 5.3: Simplified organizational chart Delta (based on interviews and Delta's website)

General outline of project Green

Project *Green* was mainly carried out by the research department and one of the businesses of Delta. As a project, *Green* was focused on changing the feedstock and process technology of a specific chemical, which could potentially influence its properties. *Green* was situated in Europe, significant research and development had to take place, and investments were high. The project fits the 'tech-discontinuities' category because new technology was used to target familiar market applications.

One of the businesses of Delta is producing a chemical which is for 80% used in a specific type of resin. The feedstock for this chemical is propylene. In 2003, demand for the resin, and therefore for the chemical, was rising and the market waited for new investments in manufacturing facilities. However, these were difficult to justify with rising propylene prices and low market prices. At the same time, the market for bio-diesel, which was introduced in the 1990s, started to grow. The business manager of the Delta business heard from a trader that a byproduct of bio-diesel could be used for producing the chemical, instead of using propylene. This was an opportunity to come up with a cheaper and more sustainable product and started the *initiation* phase of the project. After some initial market research, the business manager discussed this insight with an R&D manager who

started looking into this alternative route to manufacturing the chemical. Mid 2003, lab trials took place and in October a first patent was filed. In July 2004, the *development* phase started with the decision to build a small pilot plant on a manufacturing site in France. In 2005, after a period of trials, some initial product was send from the pilot plant to a small group of resin producers for testing purposes. No significant property differences were encountered. In May 2005, several additional patent applications took place. This period also marked the start of a study to justify investments for a plant of 10 kilotons (Kt) per annum based on the new technology on the French manufacturing site. Important information that had to be compiled for this business plan was information on developments of the new feedstock over the coming years, market developments, and a competitor and investment analysis. The executive committee of Delta's parent company agreed on the investments. Early 2006, the announcement was made that a new 10 Kt plant was to be built on the manufacturing site in France. A 14 months timeframe was applied, and the plant was scheduled to open the first half of 2007. April 2007 marked the start of production from the new plant and the *commercialization* phase. Samples were sent to customers for validation. Customers that had short qualification processes started ordering the new product in June of that year. Besides commercialization, Delta worked on a plan for developing a 100 Kt. plant in Asia were demand for the chemical was rising. In September 2007, Delta announced that this plant would be built in Thailand.

In general, Delta regards project *Green* as a successful project. The new product could be introduced into the market, and the realization of the new plant occurred quite fast and without delay. Because its new production process pulls out of the oil chain and is based on renewable feedstock, which is a hot topic in the industry, project *Green* gained a lot of media attention. Additionally, it won a corporate innovation award and three external prizes. Table 5.16 presents its key characteristics with the corresponding case study evidence.

Table 5.16: Key characteristics Green

Characteristics	**Case study evidence**
Category: *Tech-discontinuity*	'In 2008, 36 patents were filed and several of them granted in different parts of the world' *Investor's presentation* 'It is an existing application and a totally new production process, which is based on a new feedstock' *R&D manager* 'This new technology has lots of advantages, economically, environmentally, and it gave us a new marketing tool' *Business development manager* 'The chemical reaction was quite old, but putting this technology on an industrial scale was new and difficult' *Business manager*
Investment level: *High*	'For (the multinational *ed.*) it is one of the three major projects' *R&D manager* 'At the end of the business plan was the conclusion where we asked for several millions for developing this type of process' *Business development manager* 'We needed to get not only the approval from (Delta's *ed.*) director but also from the executive committee from the whole organization because it was a 2 million+ project' *R&D manager*

Market learning

Project *Green* was focused on a market segment (chemical), application (resin) and customers (resin producers) that were already known to Delta. Consequently, it already had significant market knowledge on these dimensions at the start of the project. Exploration and exploitation in market learning were combined across dimensions in the development phase and over time. Delta updated its segment knowledge in the initiation phase and again in the development phase when compiling the business plan to ask for resources to build a plant. Application need and customer knowledge were updated during all three product innovation phases. In contrast, because of the renewed underlying technology and feedstock, which could potentially influence product properties, Delta had limited product usage knowledge. It had to generate this knowledge by exploratory probes of product samples during development and an update of this knowledge during commercialization. Market knowledge integration occurred without any considerable problems (table 5.17).

Table 5.17: Market learning Green

(phase) Knowledge dimension	(period) Learning Type	Case study evidence
(Initiation)	('03-'04)	
Segment	Exploitation	'....we are already selling in this market segment' *R&D manager* 'We were very active in business intelligence....trying to understand what competitors were doing, where the market was going and also the legislation aspect of it' *Business manager*
Application	Exploitation	'Roughly 80% of our product we sell in this (resin *ed.*) application' *R&D manager* 'In the beginning we collected information on the developments in this (resin *ed.*) application' *Business manager*
Customer	Exploitation	'We wanted to target the same customers as usual' *Business manager* 'We contacted our customers and tried to gain knowledge on how they saw the future' *Business manager*
(Developm.)	('04-'07)	
Segment	Exploitation	'The business plan had estimations on developments in market volumes and prices for our product market.....It also included a competitor analysis based on patent data' *Business development manager*
Application	Exploitation	'For the business plan, we also gathered information on developments in the (resin *ed.*) field.' *Business development manager*
Product	*Exploration*	'...customers had to switch. Although the quality is the same, the product is based on different chemistry' *R&D manager* 'We sent some samples from the pilot plant to customers for testing purposes. This was a purified product, but not representative for the purification grade that we wanted to achieve, but better than nothing' *R&D manager* '...we started sending some samples in advance from the pilot plant in 2006.....to check if we were not making mistakes....we also wanted to learn about the marketing effects of green products, maybe there is a value added there..' *Business manager*
Customer	Exploitation	'We tried to do testing at our key accounts' *Business development manager* '...we learned that some of our customers, for example in the aeronautic value chain, have longer qualification processes than others' *R&D manager*
(Commerc.)	(2007)	
Application	Exploitation	'Some customers have already qualified the product in the (resin ed.) application in 2007 and bought it from mid-2007 onwards...' *Business development manager*
Product	Exploitation	
Customer	Exploitation	

Marketing function

Sales/marketing managers played a central role in the market learning of project *Green* in all three product innovation phases. Specifically in the initiation phase, the business manager of the Delta business in which project *Green* was carried out was also heavily involved. All these employees were marketing specialists in the sense that interacting with the market was part of their official task description.

The task focus of the sales/marketing managers involved in project *Green* was relatively low. They were involved in both exploration and exploitation and had other tasks next to project *Green* such as selling and answering customer questions. Therefore it can be argued that in project *Green* the marketing function was highly integrated in the mainstream organization (table 5.18).

Table 5.18: Marketing function Green

(phase; period) Marketing function	Case study evidence
(Initiation '03-'04) Business manager / Sales/marketing managers	'The sales and marketing people are in charge of selling all, or several, products of the business' *Business manager* '...I am in charge of running this business which includes these innovative developments' *Business manager* 'I asked the (sales/marketing people *ed.*) to inform me on developments in the (segment *ed.*) and the (application *ed.*)' *Business manager* 'The business manager talked with the trader about developments in the market segment' *R&D manager*
(Developm. and commercialization '04-'07) Sales/marketing managers	'The people in charge of the market chapter of the business plan, were from sales and marketing' *Business manager* 'For the market study.....the information on (segment *ed.*) and (application *ed.*) was gathered by the sales and marketing department' *Business development manager* '....sales/marketing provided samples to our customers' *R&D manager* 'At the end, sales and marketing was involved in qualification and sales of the product' *Business development manager*

Senior management involvement

With regard to senior management involvement, specifically the business manager of the Delta business in which project *Green* took place was involved in the project and its market interactions. He acted as overall project initiator and project leader, directed attention, and provided resources. Because investments were large, several board members of the chemical multinational acted as project sponsor team after the business plan for building the plant was submitted and approved in the development phase. Besides these elements of support, also elements of control could be observed. During the project, project members reported developments in market interactions to the business manager. The business manager, in turn, had to report to the executive committee of the chemical multinational (table 5.19).

Table 5.19: Senior management involvement Green

(phase; period) Senior management involvement	Case study evidence
(Initiation '03-'04) Directing	'I asked the (sales/marketing people *ed.*) to inform me on developments in (market segment *ed.*) and the (application *ed.*)' *Business manager*
(Developm. and commercialization '04-'07) Support / Control	'I asked (Business development manager *ed.*) to join the team and coordinate writing the business plan' *Business manager* 'In a few months (R&D manager *ed.*) came back to me and said it could be promising....I put in money for lab tests and a first pilot plant' *Business manager* 'All functions, also sales and marketing, reported to the business manager' *Business development manager* 'We have a multi-functional meeting every month with the business manager were we discuss progress' *Business development manager* '...we had to receive a go from the executive committee of (chemical multinational *ed.*) for building the plant...we tried to be entrepreneurs but not cowboys. When spending money (chemical multinational *ed.*) is cautious.....I also report progress to the executive committee several times a year' *Business manager*

Market knowledge generation

During the initiation phase, segment, application need, and customer knowledge for project *Green* was generated by desk research and visiting customers. In the development and commercialization phases, Delta collaborated with customers for testing purposes, which generated product usage, application need, and customer knowledge. Finally, in the development phase, Delta also used desk research in developing the business plan for building the 10 Kt plant (table 5.20).

Table 5.20 Market knowledge generation Green

(phase; period) Market knowledge generation	**Case study evidence**
(Initiation '03-'04) Desk research / Customer contacts	'...we tried to understand the market by gathering business intelligence on, for example, price predictions' *Business manager* 'The business manager talked with the trader about developments in the market segment....' *R&D manager* 'We studied price developments of the future feedstock to get a first perspective on feasibility' *R&D manager*
(Developm. and commercialization '04-'07) Desk research / Collaboration with customers	'Data for the business plan for the 10Kt plant were generated by studying existing reports on developments in the market segment.....It also included a competitor analysis based on patent data' *Business development manager* 'We tried to do testing at our key accounts' *Business development manager* '...we started sending some samples in advance from the pilot plant in 2006 to customers and gathered their feedback' *Business manager*

Market knowledge integration

For project *Green*, market knowledge integration in the initiation phase was mainly carried out through the hierarchy of authority. The business manager reviewed market insights, combined it with his own market knowledge and asked the R&D manager to look into the idea from a technical perspective. During the development phase, market knowledge was mainly integrated by using monthly recurrent project meetings. The business manager, R&D manager, and most of the other functional managers that participated in these meeting were all located at Delta's headquarters. When initial versions of the end-product could be produced, these meetings were accompanied by discussing samples (the equivalent of 'prototypes') (table 5.21).

Table 5.21: Market knowledge integration Green

(phase; period) Market knowledge integration	Case study evidence
(Initiation '03-'04) Hierarchy of authority	'I have a functional link with the business manager which is very short. If there is a good idea we can work quickly, with support of the business…This was very important in this project' *R&D manager* 'After talking to the trader, the business manager asked me to look into alternative routes' *R&D manager* 'I asked (R&D manager *ed.*) to look into this…….we like to challenge each other..' *Business manager*
(Developm. '04-'07) Recurrent meetings / Prototypes	'After the business plan was approved we had these monthly meetings we call 'copile', which is a steering meeting. Here the representatives of the departments met…….we talked about problems and opportunities that we were facing, where we were and what we had to do' *Business manager* 'For this project, because of the size, we use the copile structure. This is a team structure of 10 to 12 people from different departments, including sales and marketing that meet once a month' *Business development manager* 'Based on discussions on the initial product from the pilot plant, which looked promising, the project team decided to test some samples with customers' *Business manager*

5.4 Overall comparison

This chapter discussed the findings on projects that fall into the 'tech-discontinuities' project category. Based on studying the accumulated data from three cases, *Heat* (Alpha), *Anti-tracking* (Beta), and *Green* (Delta), it was possible to uncover several similarities and differences between cases.

Similarities

In all three cases, project members leveraged and updated segment, application need, and customer knowledge that was already available in the business unit, and searched for new product usage knowledge. This combining of exploitation and exploration was specifically noticeable in the development phase of the product innovation process. From a marketing perspective, the challenges were to develop a segment foresight to direct product research in the initiation phase, validate prototypes in the development phase, and refine market knowledge in the commercialization phase.

What were the similarities in the configuration of the marketing organization that triggered and allowed project members to carry out this market learning behavior?

First of all, in all three cases rather specialized marketing functions (application development and sales and/or marketing managers) were involved. Furthermore, the task focus of the project members that performed the marketing function was relatively low in all three cases. They were involved in both exploration *and* exploitation and next to the projects under study they were also involved in other activities that supported the running business such as selling other products and answering customer questions. In other words, the marketing function was highly integrated in the mainstream organization. In all three cases, the business unit's senior management, specifically middle managers such as product or business managers, tried to influence market learning behavior by adopting multiple roles. In the initiation phase, they directed employees acting on a lower

hierarchical level to generate specific market knowledge in an existing segment and application area. In the later phases of the product innovation project, senior managers supported market learning by providing resources to project members, expressing approval of their behavior, and acting as sounding board when necessary. Additionally, in all three cases the project members that performed the marketing function were able to contact existing customers in the initiation phase of the product innovation project and to develop collaborations in the later phases. Finally, in all three cases, the project members that performed the marketing function collaborated and interacted with other participating functional specialists without any considerable problems in the development and commercialization phases of the product development projects. Cognitive barriers between different functional specialists for knowledge integration were successfully mitigated. Important practices that were used to develop a shared language and narratives were face-to-face meetings and discussing new product prototypes.

Differences

The analysis revealed several modest differences between the organizational context of project *Heat* and project *Green*, specifically in the areas of the practices in use to generate and integrate market knowledge. Instead of using desk research, customer contacts, and conferences to generate market knowledge in the initiation phase of the product innovation project as was done in project *Heat*, project members in project *Green* merely relied on using desk research and customer contacts. With respect to market knowledge integration, an additional practice was used in project *Heat*. Besides face-to-face meeting and discussing product prototypes, team members used a cross-functional implementation framework, available within Alpha. This framework was used as 'boundary object' and decreased cognitive barriers between different functional specialists. Additionally, investment levels between *Heat* and *Green* were different. While project *Heat* required a medium level of project investments, for project *Green* these investments were higher. This explains why for project *Green* even top managers of the entire chemical corporation were directly involved, while for project *Heat* the involvement of senior management was limited to the middle and upper managers of Alpha. It could be argued that at some point in time, when investments for the 10Kt plant came up, *Green* grew beyond the responsibilities of Delta and became a corporation-wide affair.

The analysis revealed some larger differences between projects *Heat* and *Green* on one side, and project *Anti-tracking* on the other side. A main difference relates to market knowledge generation in the initiation phase of the product innovation project. Project members in *Heat* and *Green* carried out a broad scan of the environment, and developed a perspective to anticipate, and perhaps even shape the evolution of their market segment. They had discussions with several customers and complemented these insights with findings from secondary sources such as conference talks and reports. From the start, they were both sensitive to individual customer needs and to the macro forces that shaped these preferences. In contrast, project members in *Anti-tracking* were merely focused on a single customer when generating market knowledge, resulting in a very specific customer need focus. Only when it appeared that this single customer became less interested and it became difficult to commercialize the product, a broader perspective was taken. This perspective

conveyed that the market segment, in general, did not experience the problem Beta's new product was trying to solve and that the product could only be introduced if it was able to bring the same results as the commonly used solutions against a lower price. It can be argued that the late timing of developing this market insight resulted in, at least, a delay in the commercialization of the new Beta product. As a sales manager of Beta put it:

> 'The point is, this project is going on for about seven years now, and there were not really moments that you had to look forward to, that you had to meet a milestone. When we were testing prototypes and we had to decide what alternatives we wanted to continue with, I think that was the most challenging part on the technical side. On the commercial side it was the understanding that our approach had not been right. What I just explained: We did not keep track of the broader market. We did not use a helicopter view to see if this was the way to go. This understanding actually came to light about two years ago when our customer, together with us, presented the new concept at a conference for the cable industry. The response of the audience was that they already had their solutions in place. They asked us to elaborate on the benefits in comparison to these solutions. We absolutely did not have an answer to that. You can say that was the biggest challenge…the biggest shock. That was the wake up call in the project. For this project we were so focused on this one customer, that we lost the overall scope…Actually it is quite bizarre'.

Besides the relatively limited use of market knowledge generation practices in project *Anti-tracking* by the employees that performed the marketing function during the initiation phase, are other elements from the organizational configuration to blame? Results show that, in general, *Anti-tracking* was managed in a relatively informal way. Project meetings took place in an ad-hoc fashion and a lot of project investments could be realized by using non-specified resources, resulting in limited project visibility. This might be the reason that market learning activities experienced limited senior management control, and it took a while before project members became aware of their overly narrow market perspective.

6 Market-discontinuities: Additive, Diffuse, Bond, and Gears

This chapter describes the findings on cases that fall into the 'market-discontinuities' category. These projects are based on market applications that are new to the organizations in which they are carried out and on product and/or process technologies that are already known to the firm. Successively, the chapter presents the findings on cases 'Additive' (Theta), 'Diffuse' (Sigma), 'Bond' (Alpha), and 'Gears' (Alpha). Case descriptions are structured around the concepts that were presented in the conceptual framework in chapter 3. The chapter is concluded with an overall comparison.

6.1 Additive (Theta)

Theta was a business unit of a global player that produces products for the cleaning market. The business started as producer of low molecular weight polymers in the 1960s. These were internally supplied to the main business that produced downstream products. In the 1970s, Theta diversified and began manufacturing and selling low molecular weight polymers in the coatings and inks market by itself. Customers in these markets have been using Theta's polymers as ingredient for inks and coatings, which are sold to downstream customers. In 2006, the company owning Theta restructured its businesses, and Theta was sold to a large chemical company. This company integrated Theta in one of its divisions. In 2005, Theta had around 273 million Euros in annual sales and employed about 430 people (table 6.1).

Table 6.1: Key numerical data Theta 2002-2007 (based on annual reports)

Theta	2002	2003	2004	2005	2006[#]	2007
Sales (mln. Euro)	196	213	245	273	3,251	3,488
EBIT (operating profit)	23	28	25	28	250	270
EBIT/sales ratio (%)	11.7	13.1	10.2	10.3	7.7	7.7
Employees	500	500	430	430	6,900	5,500
R&D expenses (mln. Euro)	13	11	11	10	132	130
R&D/sales ratio (%)	6.6	5.2	4.5	3.7	4.1	3.7

[#] Figures of the division of the large chemical company in which Theta was integrated in 2006.

Although Theta had two global product lines, the organization was mainly focused on the U.S. and Europe. Each product line had its own marketing and sales department. Additionally, there was a central R&D department. Figure 6.1 presents a simplified organizational chart. Recently, Theta carried out project *Additive*.

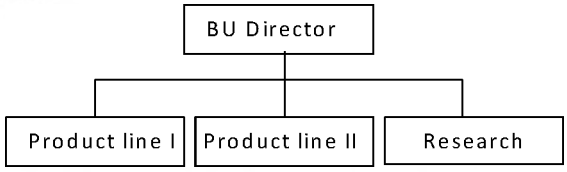


Figure 6.1: Simplified organizational chart Theta (based on interviews)

General outline of project Additive

Project *Additive* started in 1999. At that time the inks market was facing commoditization and Theta's plants were underutilized. Partly based on the advice of external consultants, Theta decided to put efforts in finding new application markets for their low molecular weight polymers. The organization put a value proposition team together to identify ideas that were present in the organization. This started the *initiation* phase. After scanning about a hundred ideas and carrying out some initial lab tests, several ideas looked promising. One of these ideas was fine-tuning the polymers so they could be used as additives to increase viscosity and improve the flow of plastics. A small team was put together to look deeper into this idea. Based on additional lab tests and market research reports this team tried to get knowledgeable about the plastics market by identifying different applications and large players. The team identified that their product had the potential to be used as plasticizer, flow modifier, and rubber modifier. They started contacting large plastics producers to discuss these ideas. This started the *development* phase in 2001. Early in this phase, Theta hired several business development people that had extensive experience in the plastics industry. Among them was the project leader for project *Additive*, which had become an approved project after the presentation of a business case at the start of the development phase. Interactions with plastic producers resulted in more knowledge about the plastics market segment. It appeared that some application ideas, such as plasticizers and rubber modifiers were dead ends because of relatively weak value propositions. However, together with potential customers, the project team also discovered new potential applications such as polymer dispersing and the extension of polymer chains. Specifically this last application appeared to attract attention. Instead of lowering the total polymer weight of plastics, several samples increased it resulting in, for instance, better mechanical properties. The team learned that while the application market for flow modifiers and polymer dispersants is large, it is very competitive and has low margins. In contrast, the application market for polymer chain extenders is smaller but emerging, has little competition, and has high margins. Gradually, the project team focused more and more on the chain extender application during development. After a period of trials at potential customers, the project team managed to move into a first *commercialization* trajectory in 2004. At that time, senior management had already reduced human and financial resources to the team because the business plan approval was based on the generation of sales in an earlier stage. From their perspective, it simply took too long to reach acceptable sales levels. With very little resources the team tried to commercialize its product with other plastic producers and develop the business in 2005 and 2006. In 2006 it became clear that Theta would be sold. Eventually, Theta's buyer (i.e. the large chemical company) decided to integrate the project into a specific divisional new business department which allows small start-ups to grow to a specific size.

Overall, project *Additive* required a medium level of investment. In general, Theta and the large chemical company see *Additive* as a relatively successful project. The product could be introduced into the market and generated spin-off projects. The project fits the 'market-discontinuities' category because familiar technology was used to target new market applications. Table 6.2 presents project *Additive's* key characteristics with the corresponding case study evidence.

Table 6.2: Key characteristics Additive

Characteristics	Case study evidence
Category: *Market-discontinuity*	'The case is that we use the exact same chemistry to develop the product than is used to produce the products for coatings and inks' *Key account development manager* '...the idea was to take the same products, make small adaptations, and use them as additives for thermoplastics' *Key account development manager* '..for (Theta *ed.*) it was more or less, how do I get more out of my existing product line' *Head of new markets large chemical company* '...the product stayed within the technology, but focused on new market applications' *Business manager* '.....we knew very well what type of resins we could make with this technology...we had worked with this technology very, very broadly, so we were very convinced that we had a broad synthesis stage to make a lot of potential additives....We did not know what was specifically needed in the market place' *Senior research associate*
Investment level: *Medium*	'...there was significant funding...a few millions I think' *Business manager* 'No investments in a plant were needed, that is a lucky situation otherwise you talk about a 10 million+ investment....that was a clear 'no go'' *Business manager*

Market learning

Project *Additive* was focused on a market segment (plastics), applications (chain extension, flow modifying, and dispersing) and customers (plastics producers and plastic recyclers) that were totally new to Theta. Consequently, it had to develop new market knowledge on these dimensions (i.e. exploration) and refine it (i.e. exploitation) during the product innovation trajectory. In contrast, because Theta's existing products were marginally changed, it already had product usage knowledge. It refined this knowledge (i.e. exploitation) during the product innovation trajectory.

Exploration and exploitation in market learning were combined across market knowledge dimensions (in a single product innovation phase) and over time. Significant market knowledge was generated and market knowledge integration occurred without any considerable problems (table 6.3).

Table 6.3: Market learning Additive

(phase) Knowledge dimension	(period) Learning Type	Case study evidence
(Initiation)	('99-'01)	
Segment	*Exploration*	'The value proposition team was doing work on market studies' *Senior research associate*
Product	Exploitation	'The initial thing was looking at the literature: what market segments use low molecular weight polymers...' *Business manager*
(Developm.)	('01-'04)	
Application	*Exploration*	'We developed plasticizer prototypes...when companies evaluated them we learned that their performance was comparable with products in the market. Because our chemistry was more expensive we decided to focus more on other applications' *Senior research associate* 'After feedback from a potential partner, we converged to the chain extender having tremendous value....' *Senior research associate* '....market feedback resulted in unexpected results: this is not a plasticizer, this is a dispersant. The people did not know what a dispersant was, or what you disperse....it was a little bit shooting in the dark' *Business manager*
Product	Exploitation	'In the beginning they had low molecular weight additives, which are typically used as solvents, or dispersants, or flow modifiers. It is a little bit different, but the idea is the same: getting lower polymer weight, lower viscosity and better flow...then they made a sample which increased viscosity, so the opposite approach...that was what potential customers really loved' *Business manager*
Customer	*Exploration*	'....In the following months, we made contact with all the major plastic companies in North America, Europe and Korea' *Senior research associate* 'It appeared difficult to work with PET recyclers. They do not have the key knowledge. If you go in with a very technical presentation, people do not know what to do. The recyclers are very much what you think the recyclers are. They are guys with a big truck buying scrap...' *Business manager* 'Potential customers were approached to see if we could bring value..' *Key account development manager*
(Commerc.)	(2004)	
Application	Exploitation	'...at that time (2004 *ed.*) we developed the first application specification and had some commercial trials' *Senior research associate*
Product	Exploitation	'In 2004 we could commercialize our product in the chain extender application with a potential customer that was working with a material that was very new to them also....it helped that our product fitted that well' *Key account development manager*
Customer	Exploitation	

Marketing function

The central roles in market learning in project *Additive* were in the hands of several marketing managers and business development managers (3 on average) and the project leader. These project members were marketing specialists in a sense that interacting with customers was part of their official task description. Several employees, among which the project leader, were plastic experts that were hired by Theta in the development phase. Although the project leader and business development managers were active in both exploration and exploitation their task focus was relatively high. They were totally dedicated to project *Additive* and were freed from other responsibilities. In other words, they were differentiated from the mainstream organization (table 6.4).

Table 6.4: Marketing function Additive

(phase; period) Marketing function	Case study evidence
(Initiation '99-'01) Marketing managers	'The value proposition team was formed by people of marketing, technical service, R&D...marketing was doing work on market studies' *Senior research associate* '...they put people aside and assigned them to look at new market segments' *Business manager*
(Developm. and commerc. '01-'04) Project leader / Business development managers	'What really made a difference was the new man leading these efforts (project leader *ed.*)...he knew how to open doors... In the following months, he made contact with all the major plastic companies in North America, Europe and Korea' *Senior research associate* 'Except for this leader, who was new to the organization, we had a sales and a marketing person in the team....very early we started activities in Europe with (Key account development manager *ed.*) and with a business development manager in Asia...All people were totally dedicated to this project and freed from other activities' *Senior research associate* 'We had a team of about ten people that was totally dedicated to plastic additives...My function basically was market research, selling, and some product management' *Key account development manager*

Senior management involvement

The top managers of Theta were, to some extent, involved in *Additive's* market learning. During initiation, they framed the search for new market knowledge by emphasizing the strategic choice to look into new market segments where existing Theta products could fit. During development and commercialization, they supported the team by allocating human and financial resources after they had approved the business plan's market analyses and return on investment predictions. However, they also controlled market learning. The project leader had to report on a monthly basis and when return on investments took longer than expected, Theta's top diminished team resources by forcing several business developers to return to their original functions in the existing product lines. This move accelerated the sole focus on the chain extender application.

Table 6.5: Senior management involvement Additive

(phase; period) Senior management involvement	Case study evidence
(Initiation '99-'01) Framing	'The strategy was to enlarge the application area of (Theta's ed.) products…' *Key account development manager* '…they (top managers of Theta *ed.*) put people aside and assigned them to look at new market segments…they had to stay within the technology but could basically look into whatever market they wanted, it could be food, diapers, tires, cars…' *Business manager* '(Theta) set up a new business organization…to develop a third leg to its business' *Senior research associate*
(Developm. and commercialization '01-'04) Support / Control	'..we had full support from the top of the organization….to bring people together and setting up a plastics application lab' *Senior research associate* 'We had full support of the leadership of the company….but every move we made was very well scrutinized….we had meetings with the executive team every month where we gave updates. Beyond that we had our budget monitored extremely closely…because the company wanted to make sure continuous support meant something' *Senior research associate* '…Because we did not meet our financial targets, people from the team were sent back to the 'normal' business. They (senior management Theta *ed.*) reduced the marketing resources available to the team' *Key account development manager*

Market knowledge generation

In the initiation phase, market knowledge was generated and refined by doing desk research on the plastics segment, focusing on the use of low molecular weight polymers. In the development and commercialization phases, market knowledge was mainly generated and refined by collaborating with potential customers to test prototypes. Additionally, market knowledge generation was accelerated by hiring several segment specialists who had deep experience in the plastics field, which was a new market segment for Theta (table 6.6).

Table 6.6: Market knowledge generation Additive

(phase; period) Market knowledge generation	Case study evidence
(Initiation '99-'01) Desk research	'Initially it was paperwork….buy a market study on low molecular weight polymers and where they are going into…' *Business manager*
(Developm. and commercialization '01-'04) Collaboration with potential customers / Hiring segment specialists	'..some team members talked to potential customers to discuss product prototypes' *Senior research associate* '..we managed to get very close with potential customers…we had either partnerships, joint developments, or close relationships' *Senior research associate* A joint application patent was filed for in 2003, involving Theta and a customer *patent* '..I was hired because they did have limited marketing competences in this field. I have worked for over 20 years in developing plastics' *Key account development manager* The project leader that was hired had 20+ years of experience in the plastics field *press release*

Market knowledge integration

For project *Additive*, market knowledge integration in the initiation phase occurred by the value proposition team using their internal organizational network to collect ideas. Later on, during development and commercialization, recurrent team meetings were used, and prototypes were discussed. The team also used a cross-functional project implementation framework, brought in by the project manager, which was very influential in the organization. The use of this framework resulted in common language and awareness of different responsibilities across the team providing additional support for market knowledge integration (table 6.7).

Table 6.7: Market knowledge integration Additive

(phase; period) Market knowledge integration	**Case study evidence**
(Initiation '99-'01) Internal organizational network	'The value proposition team tried to develop ideas by talking to people across the company...' *Senior research associate*
(Developm. and commercialization '01-'04) Recurrent meetings / Prototypes / Implementation framework	'We (technical and marketing people *ed.*) were working as a team...with official meetings and joint potential customer visits' *Senior research associate* 'We made and discussed a lot of samples internally, to find out if we could bring any value in these applications...' *Senior research associate* 'The project leader used a 'market driven innovation' style....we did not only push the technology, but also discussed potential product concepts' *Senior research associate* '...very early they had business development people on board...they had a philosophy of 'market driven innovation' which was some kind of book describing a stage-gate development process that was very influential in (Theta *ed.*)' *Business manager*

6.2 Diffuse (Sigma)

Sigma is a business unit of a multinational chemical company. The core product of Sigma is a transparent engineering plastic invented by the chemical multinational and introduced into the market in the late 1930s. Major market segments for the product are furniture, interior design, and glazing. Sigma's products, in sheet form, are mainly sold via distributors and downstream fabricators who sell their products to other organizations and the general public. The organization operates worldwide but has a core focus on Europe. In 2005 and 2007, the chemical multinational restructured its portfolio and pooled several business units together. In 2008, Sigma had around 1,400 million Euros in annual sales and employed about 4,000 people (table 6.8).

Table 6.8: Key numerical data Sigma 2002-2008 (based on annual reports)

Sigma	**2002**	**2003**	**2004**	**2005[#]**	**2006**	**2007[^]**	**2008**
Sales (mln. Euro)	301	279	320	894	967	1,442	1,397
EBIT (operating profit)	42	31	41	103	111	120	43
EBIT/sales ratio (%)	14.0	11.1	12.8	11.5	11.5	8.3	3.1
Employees	843	755	835	2,271	2,467	4,108	4,026
R&D expenses (mln. Euro)	10	9	10	28	27	40	40
R&D/sales ratio (%)	3.3	3.2	3.1	3.1	2.8	2.8	2.9

[#] Figures after restructuring in 2005

[^] Figures after restructuring in 2007

In 2003, Sigma operated with four product lines, of which two were defined based on production technology and two were focusing on a specific market segment. Additionally, it had a separate sales organization and a central R&D department. Figure 6.2 presents a simplified organizational chart. Recently, Sigma carried out project *Diffuse*.

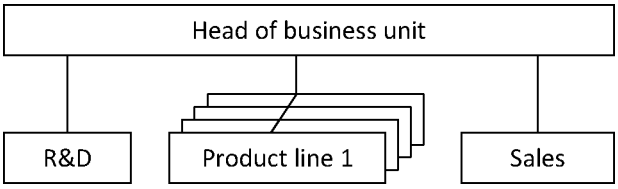


Figure 6.2: Simplified organizational chart Sigma (based on interviews and Sigma's website)

General outline of project Diffuse

Project *Diffuse* was mainly carried out by a business developer and a product manager of one of the product lines of Sigma. As a project, *Diffuse* was developed in Europe and required a low level of investment. Relatively little technical development work had to take place and the product could be manufactured in existing facilities. The project fits the 'market-discontinuities' category because a familiar product was used to target a new market application.

In the mid-90s, Sigma developed and introduced a specific sheet for the light management market segment. This sheet has specific colorless light diffusing particles that cause light to diffuse forward and was specifically engineered for edge-light applications. It accepts light through its edges and redirects it to the surface for bright uniform illumination. The sheet is used in panels for airports, shopping malls, restaurants, and bus stops. In 2002, a business developer made some incremental adaptations to the product in response to customer feedback which caused renewed internal and external attention for this type of sheet. In 2003 Sigma's sales organization was approached by a potential customer who showed interest in the sheet, which started the *initiation* phase of the project. This organization was a multinational that, among other products, develops and sells traffic safety solutions. Sigma's sales organization established the contact between the potential customer and Sigma's business developer. The business developer met with the potential customer to discuss ideas which started the *development* phase. After some additional meetings, the business developer found out that the potential customer was working on an innovative license plate system. The novel feature was that the license plate was no longer lit by an external source, but by light-emitting diodes (LEDs) that emit light into a small light diffusing transparent panel with on top of that a newly developed transparent license plate. The idea was that Sigma would supply the light diffusing transparent panel. After a period of testing with different samples and using a mathematical model developed by Sigma in 2002, the two parties found a suitable sheet thickness. Meanwhile the potential customer managed to develop the other parts of the license plate system and to set up a supply chain in 2005, which marks the start of the *commercialization* phase. In the same period, Sigma's business developer handed the project over to a product manager, because he moved to a

position for Sigma's operations in another region. Sigma's potential customer introduced the new license plate system in 2006, which also started sales of Sigma's sheet in this application.

In general, Sigma regards project *Diffuse* as a success. Its sheet could be introduced in this application and the project resulted in a positive return on investment. However, Sigma's customer clearly overestimated the sales growth of the new license plate system, and the project resulted in limited spin-off projects in the same application area. Table 6.9 presents the key characteristics of project *Diffuse* with the corresponding case study evidence.

Table 6.9: Key characteristics Diffuse

Characteristics	**Case study evidence**
Category: *Market-discontinuity*	'...we had gained a business opportunity in a new specialty application, where our existing material had some specific features which were of benefit for the customer' *Product manager* 'We were already selling this product.....and the license plate system was a new application for us' *Business developer*
Investment level: *Low*	'We did not need new machines, and could very easily implement it in our production process' *Business developer* 'I did not need so much investments and resources for this project....it would be more difficult if I needed, let's say, one million Euros to develop a product' *Business developer* '...but generally speaking, it was a smaller project so there was not a real need for a strict project set-up, like a project team and stage-gate and things like that' *Product manager*

Market learning

Project *Diffuse* was focused on a market segment (light management) that was already known to Sigma. Additionally, the organization already had significant product usage knowledge. In contrast, Sigma had to develop and refine new customer and application need knowledge in the development and commercialization phases. The integration of market knowledge that was generated occurred without any considerable problems (table 6.10).

Table 6.10: Market learning Diffuse

(phase) Knowledge dimension	(period) Learning Type	Case study evidence
(Initiation)	(2003)	
Segment	Exploitation	'Lighting was already a defined market segment where we sell our products' *Business developer* 'We always worked on lighting applications in the past…' *Head of NBD and innovation* 'I tried to look at the volume and development of the market for edge-lit material for signage' *Business developer* 'Edge-lit signage is not new to the market, but it is a trend' *Product manager*
Product	Exploitation	'We already had a good position with our existing product in the field of lighting applications' *Product manager* 'In the advertising industry they mainly use our sheets in three standard sizes…I developed a mathematical model by which we could adapt our product recipes to the sheet size to achieve optimal performance (in 2002 *ed.*)…We received a positive market feedback to that (in 2003 *ed.*)' *Business developer*
(Developm.)	('03-'05)	
Application	*Exploration*	'In the early phases, the contact person at (customer *ed.*) was only one guy. In this stage he was working on small illuminated signs, but I did not really know what the application was because he did not open it to me…to be honest I do not think that, at that time, he already decided to work on a license plate system' *Business developer* 'We learned that developing the light transparent license plate was more difficult than creating the lighting unit' *Business developer* '…we had gained a business opportunity in a new specialty application, where our existing material had some specific features which were of benefit for the customer.' *Product manager*
Product	Exploitation	'Development started when (business developer *ed.*) was focusing on product details…what were the desired incremental modifications in the formulation to enhance properties. I actually continued with the results of these trials' *Product manager* 'They needed it in a specific shape, so we produced sheets and laser-cut them in specific shapes…There where several design back and forths to come to the right product' *business developer*
Customer	*Exploration*	'(Customer ed.) was not a customer at that time' *Business developer* 'At the start I visited this guy (at the customer *ed.*), and he had a small laboratory and was working with students…but at some point in time the customer really wanted to commercialize this license plate system' *Business developer*
(Commerc.)	('05-'06)	
Application	Exploitation	'After the trials I was discussing specifications such as guarantees and performance defect values and so on' *Product manager* '…they were also asking about pricing' *Product manager* 'Let me see…I can find an e-mail here from (product manager ed.) to (customer ed.) on pricing and so on. At that time they were already in the phase to make a real product for it and put it in production' *business developer* 'At the time around specification, other people from (customer ed.) became involved. I think more than 60% of the communication was with this guy (that started the project at the customer *ed.*) and for a minor part we had contact with the product managers and specification people at the customer' *Product manager*
Product	Exploitation	
Customer	Exploitation	

Marketing function

During initiation and development, the central role in market learning for project *Diffuse* was in the hands of the business developer. Mainly because the business developer changed jobs in 2005, this central role came into the hands of a product manager from one of Sigma's product lines in the commercialization phase. Both employees were marketing specialists because interacting with customers was part of their official task description. The task focus of the business developer was relatively low. He focused on both exploration *and* exploitation in project *Diffuse* but was also involved in other Sigma projects, some of them focused on incremental product updates. Also the product manager had additional (routine) tasks next to project *Diffuse*. Thus, both employees were highly integrated in the mainstream organization.

Table 6.11: Marketing function Diffuse

(phase; period) Marketing function	**Case study evidence**
(Initiation and developm. '03-'05) Business developer	'We call 'product management' the marketing of our organization. Besides the heads of the project lines I was a fifth player in marketing, involved in new business development for all the product lines' *Business developer* 'I would say I had five other projects next to this one, most of them focused on technical improvements of existing products' *Business developer* 'I was in direct contact with (customer ed.) there was no sales involved' *Business developer*
(Commerc. '05-'06) Product manager	'At the time of the project I did product management and marketing in one of our product lines….I was responsible for specialty applications' *Product manager* 'At that time I took over the project from (business developer *ed.*), and continued the contact with (customer *ed.*)…' *Product manager* 'Let me see…I can find an e-mail here from (product manager ed.) to (customer ed.) on pricing and so on'. *Business developer*

Senior management involvement

To some extent, the senior management team of Sigma was involved in the market learning that took place via project *Diffuse*. First of all, they framed the strategic direction by asking employees to focus on new specialty applications in the light management segment. Additionally, they provided the resources that supported the business developer and the product manager to carry out the project. Although senior management was aware of the project, specifically when it was transferred from the business developer to the product manager, they had little involvement in controlling its progress. One of the reasons for that was that the project did not require substantial investments (Table 6.12).

Table 6.12: Senior management involvement Diffuse

(phase; period) Senior management involvement	Case study evidence
(Initiation 2003) Framing	'It was really the strategy of the organization to focus on new specialties where our products could fit. In these applications there is a specific value for the customer' *Product manager* '....lighting applications have always been an organizational focus point' *Product manager* 'Light applications are a strategic focus' *Business developer* 'We want to focus more on specialties....We always worked on 'light' and it is also a current focus point. We are only a small business line with limited resources, it makes sense to focus' *Head of NBD and Innovation*
(Developm. and commercialization '03-'06) Support / (Limited) control	'I had the resources and freedom to pursue this opportunity (project diffuse *ed.*)...my policy was starting it up and present it when it is running..... it would be more difficult if I needed, let's say, one million Euros to develop a product' *Business developer* '...but generally speaking, it was a smaller project so there was not a real need for a strict project set-up, like a project team and stage-gate and things like that' *Product manager* 'Higher management was informed....but there was no major management decision necessary where usually higher management is involved such as specific investments' *Product manager*

Market knowledge generation

During the initiation phase, segment knowledge and product usage knowledge were updated by presenting at trade fairs and by desk research on sales figures. In the development and commercialization phases, Sigma collaborated with the customer to generate and update application need, product usage, and customer knowledge (table 6.13).

Table 6.13: Market knowledge generation Diffuse

(phase; period) Market knowledge generation	Case study evidence
(Initiation 2003) Trade fairs / Desk research	'The renewed product that we introduced in 2002 was well accepted. From our sales department I knew we were going to raise sales with about 25% in 2003 ' *Business developer* 'From attending trade-fairs we knew that ultra-slim displays really were a trend in the light management market' *Product manager*
(Developm. and commercialization '03-'06) Collaboration with potential customer	'We had some back and forth development, working with (customer *ed.*) *Business developer* '...(business developer *ed.*) had already developed more or less some solutions together with (customer *ed.*) when I started the next phase: going into production' *Product manager* '...for example my colleague had a very close relationship with (customer ed.) to develop this license plate system' *Head of NBD and Innovation*

Market knowledge integration

For project *Diffuse*, market knowledge integration in the initiation phase was mainly carried out by using the internal organizational network. During the development and commercialization phases,

this integration took place by using recurrent meetings, which were accompanied by discussing customer feedback on prototypes (table 6.14).

Table 6.14: Market knowledge integration Diffuse

(phase; period) Market knowledge integration	Case study evidence
(Initiation 2003) Internal organizational network	'I was not contacted directly by (customer *ed.*). They knew about the product and they called our sales organization. Someone in our sales organization knew that I was working with this product, so they came to me. I made the contact and it stayed with me' *Business developer*
(Developm. and commercialization '03-'06) Recurrent meetings / Prototypes	'Internally I had meetings with the lab who created the raw sheet and the people here in our customer lab who had the laser cutting equipment and who fabricated the different designs' *Business developer* 'I had meetings with people in production, our sales department when it was about pricing and payment terms, and some quality people concerning specifications' *Product manager*

6.3 Bond (Alpha)

Alpha is a business unit of a chemical multinational company and a global player in the engineering plastics industry. Important end markets of Alpha's products are the automotive, electrical and electronics (E&E), and the packaging industries. Companies in these end markets use Alpha's materials to fabricate their own products which they sell to the general public. In 2008, the business unit had around 760 million Euros in annual sales and employed about 1,650 people (table 6.15).

Table 6.15: Key numerical data Alpha 2002-2008 (based on annual reports)

Alpha	2002	2003	2004	2005	2006	2007	2008
Sales (mln. Euro)	579	566	624	705	735	807	761
EBIT (operating profit)	36	29	46	87	118	98	58
EBIT/sales ratio (%)	6.2	5.1	7.4	12.3	16.1	12.1	7.6
Employees	1,190	1,204	1,158	1,273	1,242	1,462	1,649
R&D expenses (mln. Euro)	26	26	24	27	31	38	42
R&D/sales ratio (%)	4.5	4.6	3.8	3.8	4.2	4.7	5.5

Alpha has a matrix organization. The main activities are divided into three regions and four global product lines. Each product line has a business manager and three regional product managers. The product lines have their own R&D. Additionally, there are regional development and sales teams that focus on important multi-product end-markets such as automotive and E&E. Figure 5.1 presents a simplified organizational chart. Recently, Alpha has invested resources in project *Bond*.

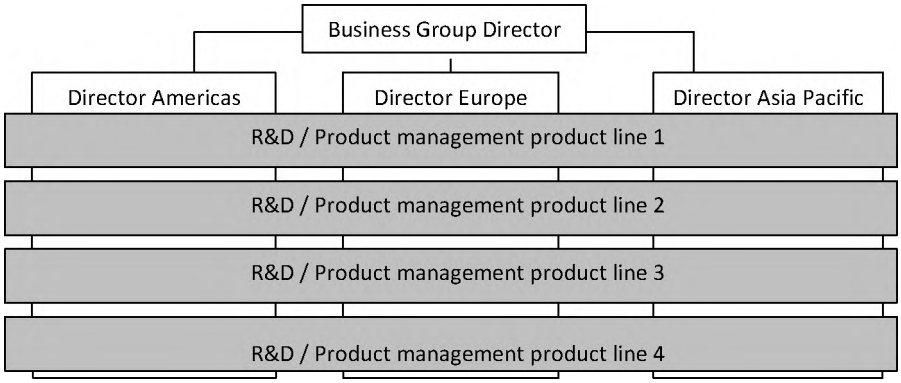


Figure 6.3: Simplified organizational chart Alpha (based on interviews)

General outline of project Bond

Project *Bond* was carried out in one of Alpha's four globally operating product lines. Among other applications, the plastic of this product line is used in automotive and E&E applications. The main developments in project *Bond* took place in Europe. However in the U.S., Alpha employees were active in similar efforts. Project *Bond* required a medium level of investment. Several employees were fully dedicated to the project but 'off the shelf' products were used. The project fits the 'market-discontinuities' category because familiar technology was used to target new market applications.

In 2005, a manufacturer of golf shoes was interested in replacing the metal base of golf shoes spikes, which were over-moulded with rubber, with an engineering plastic that could resist the temperatures of the over-moulding manufacturing process. In its search for a supplier it contacted Alpha, which was advertising with its high temperature plastic. After doing some tests, it appeared that Alpha's material behaved remarkably well during the production process. This triggered Alpha to *initiate* a project that focused on replacing metal backbones of metal/rubber hybrid components by Alpha's material. The organization further framed the market segment of metal/rubber hybrid components by heavily focusing on automotive applications, where potential volumes are large and metal replacement for weight saving was high on the agenda. After some in-house tests and studying market research reports organizational members believed that they could bring value in anti-vibration applications, such as strut mounts and exhaust hangers. They managed to convince potential customers to start testing programs with Alpha's engineering plastic instead of metal in metal/rubber anti-vibration applications which started the *development* phase in 2006. During this phase, in which Alpha collaborated with a group of potential customers, it learned that cheaper materials could also serve customer needs in lots of anti-vibration applications, and that it was very hard to move further in that direction. However, partly due to collaborative efforts with potential customers, other applications in the metal/rubber market segment were identified: window seals, and oil seals. After slightly changing the application scope, Alpha managed to get their material approved for an oil seal and a window seal application in projects that first tier automotive suppliers were doing with automotive OEMs, marking the start of the *commercialization* phase in 2008. In that

same year the automotive OEMs planned to introduce their vehicles with Alpha's material in 2009 and 2010. Additionally, several spin-off projects were under development.

In general, Alpha regards project *Bond* as a successful project. The product could be introduced into the market, and spin-off projects were realized. However, some respondents argued that it took relatively long to realize that anti-vibration was not the best application area to focus on. Table 6.16 presents project *Bond's* key characteristics with the corresponding case study evidence.

Table 6.16: Key characteristics Bond

Characteristics	**Case study evidence**
Category: *Market-discontinuity*	'The products we used were off the shelf products' *App. development manager* '..for (Bond *ed.*) we are using existing grades in new applications...we really started with limited market knowledge' *Marketing manager*
Investment level: *Medium*	'.....if you invest a couple of hundred thousand Euros, you want, at least, earn it back' *App. development manager* 'The products that we use are off the shelf products' *App. development manager*

Market learning

Project *Bond* was focused on a market segment (automotive rubber/metal hybrid components), applications (anti-vibration, window seals, and oil seals) and customers (tier 1 automotive suppliers) that were all new to Alpha. Consequently, it had to generate and refine market knowledge on these dimensions during the product innovation trajectory. In contrast, because Alpha used existing plastic grades it already had some product usage knowledge. It refined this knowledge during the product innovation trajectory.

Exploration and exploitation in market learning were combined over time and across dimensions. Sufficient market knowledge was generated and market knowledge integration occurred without any considerable problems (table 6.17).

Table 6.17: Market learning Bond

(phase) Knowledge dimension	(period) Learning Type	Case study evidence
(Initiation)	('05-'06)	
Segment	*Exploration*	'...I looked at what applications in automotive were interesting...then I tried to categorize them...and tried to search information on different producers...basically it was a market study focused on searching for applications where our product grades potentially brought value' *App. development manager*
Product	Exploitation	'...at the start we identified where to act and where our grades could bring value...It is an interesting market, but with huge competition' *Business development manager*
(Developm.)	('06-'08)	
Application	*Exploration*	'..at a customer we proposed an anti-vibration application...but ended up at another division where they do sealing...which had more fit with our product' *Business development manager*
Product	Exploitation	'We came very close to meeting requirements with our grade in the prototype stage...but when we put it in the production process (of the customer *ed.*) it was only metal to pass...' *Business development manager*
Customer	*Exploration*	'..lots of times we got in contact with potential customers by cold calling, via other contacts or searching for names on the automotive engineers website...just trying to network into a company you don't know' *Business development manager*
(Commerc.)	('08-'10)	
Application	Exploitation	'In the window seal project, I talked to the customer and they postponed the vehicle introduction to June (2009 *ed.*) this year' *Business development manager*
Product	Exploitation	
Customer	Exploitation	'At one customer we did tests and calculations and start delivering in 2010...it is not a prospect, but a project' *Business development manager*

Marketing function

Application development managers and business development managers played a central role in the market learning that took place via project *Bond*. All employees that were involved in the project were marketing specialists because interacting with customers was part of their official task description. Although these managers were active in both exploration *and* exploitation in market learning their task focus was relatively high. They were totally dedicated to project *Bond* and were freed from other responsibilities. In other words, they were differentiated from the mainstream organization (table 6.18).

Table 6.18: Marketing function Bond

(phase; period) Marketing function	Case study evidence
(Initiation '05-'06) Application development managers	'...I am only involved in (Bond *ed.*), but within this project there are some sub-projects at the application level' *App. development manager* ...I do new business development in this product line....solely looking at innovative things, outside the current market segments...' *App. development manager* '...together with customers I look into applications that they want to carry out in plastics' *App. development manager*
(Developm. '06-'08) Application development managers / Business development managers	'...I am paid by the product line to find new business and customers, focusing on (Bond *ed*)' *Business development manager* '..App. development managers have a more technical focus, business development managers are focused on the market...but there is some overlap.... *Business development manager* '...I tried to contact several door seals manufacturers' *App. development manager*
(Commerc. '08-'10) Business development managers	'I delivered a lot of samples and calculations to get commercial approvals' *Business development manager* '..If there is nobody assigned and we are not selling to this customer yet...I do the whole trajectory myself, including pricing' *Business development manager*

Senior management involvement

Several senior managers of Alpha were involved in project *Bond*. They were present in the Global Product Team which consists of the business manager, the global marketing manager, the R&D manager and the product managers of the product line. Specifically the European and U.S. product managers were involved. During initiation, they framed the search for new market knowledge by emphasizing the strategic choice to look into new market segments where existing high heat plastic grades could fit. During development and commercialization, these managers employed a mixture of support and control. Support concerned facilitating project members by means of providing resources and freedom to be active in the project's day-to-day market learning activities and acting as sounding board. The product managers controlled market learning by having monthly discussion with project members on progress in market interactions, detecting deviations from original plans, and taking action when it was deemed necessary. Finally, in 2008 project *Bond* became part of an Alpha-wide innovation program, which resulted in additional project resources. However, these extra resources were accompanied by an enforced focus on the oil seal application (table 6.19).

Table 6.19: Senior management involvement Bond

(phase; period) Senior management involvement	**Case study evidence**
(Initiation '05-'06) Framing	'The strategy is to apply our existing grades as broadly as possible' *App. development manager* 'I do new business development in this product line.....When I am reporting on new application ideas to management, I already have done a feasibility analysis' *App. development manager* '...We look for innovation by optimizing existing products...this means adapting them for applications in which they replace other materials such as metals' *Interview Director Alpha in magazine, 2004* 'We want to combine developing new grades for existing market applications and finding new applications where existing grades can be applied' *Business manager*
(Developm. and commercialization '06-'10) Support / Control	'I must have a valid argumentation when asking for resources from the product manager and research manager....they test me on that' *App. development manager* 'Resources were provided by the product manager' *Business development manager* 'Our reporting system from a formal standpoint is a monthly report on progress to the product manager' *Business development manager*

Market knowledge generation

During the initiation phase, segment knowledge was generated and product usage knowledge was updated by using desk research and visiting conferences to receive initial feedback on ideas and get in contact with potential customers. Although it was not available in the organization, the application development manager that carried out the marketing function also expressed his need for a framework to structurally generate market information in the initiation phase. In the development and commercialization phases, Alpha collaborated with several potential customers for testing purposes. These collaborations generated product usage, application need, and customer knowledge. Additionally, market knowledge generation was accelerated by hiring a new employee that was already a specialist within the newly defined market segment (table 6.20).

Table 6.20 Market knowledge generation Bond

(phase; period) Market knowledge generation	**Case study evidence**
(Initiation '05-'06) Desk research / Conferences	'In the early stage we wanted to get knowledgeable about the market....we looked at overviews on what customers and manufacturers worked with rubber components' *Application development manager* Application development manager presents at high performance plastics conference on high demanding metal-to-plastics replacements *Conference proceedings 2005* 'I was actually in need of some structure to structurally collect market information. Some kind of innovation funnel. I could not use our usual project management framework because that only fits relatively simple product upgrades, not new business development things' *Application development manager*
(Developm. and commercialization '06-'10) Collaboration with potential customers / Hiring segment specialist	'...from 2006 onwards we got involved in several joint projects with potential customers...with investments from both sides...The customer is evaluating it or is making a tool for testing, and we invest in supplying the material' *Business development manager* '...the other business development manager was just hired...he is coming from a potential customer...He was hired in 2008 to focus on E&E, but at the end it was really convenient to use his network for the oil seal application, because he is coming from such a company' *Business development manager*

Market knowledge integration

Because there was only one function (i.e. application development) involved in market learning during initiation, market knowledge was integrated with technological knowledge by a single employee. During the development and commercialization phases, market knowledge was mainly integrated by using recurrent project meetings involving different functional specialist. In some of these meetings, discussing prototypes and potential customer test results provided additional support for knowledge integration. Finally, the use of an organization-wide used cross-functional project implementation framework (i.e. PTO tool), which brought common language and awareness of different responsibilities across the team, also supported market knowledge integration (table 6.21).

Table 6.21: Market knowledge integration Bond

(phase; period) Market knowledge integration	Case study evidence
(Initiation '05-'06) Only one function involved in Bond	'I was working quite independently in the beginning…I am the project owner' *App. development manager* 'I have a double role, I do application development and business development' *App. development manager*
(Developm. and commercialization '06-'10) Recurrent meetings / Prototypes / Implementation framework	'We had team meetings involving business development and application development people where we set up value propositions and discussed applications' *Business development manager* 'Internally, we discussed prototypes with all people involved' *Application development manager* 'We used the PTO tool to define responsibilities and to keep track on the progress of sub-projects as a team' *Application development manager* '…that part is probably the most structured part of program management, using the PTO tool…you have different phases: prospect, evaluation, technical approval, commercial approval and commercialization' *Business development manager*

6.4 Gears (Alpha)

Just as project *Bond*, project *Gears* was carried out in the high temperature plastic product line of Alpha. Therefore this section will leave out the description of Alpha and will start directly with the general outline of project *Gears*.

General outline of project Gears

Project *Gears* was *initiated* in 2003. At that time, Alpha's Asia Pacific organization was selling relatively more material than its European and U.S. counterparts. To some extent this was understandable because of the high concentration of E&E manufacturers in Asia. However, a closer look revealed that a significant number of downstream processors from Asia were using the material to develop gears which were used in the two-wheelers industry. These processors used the material because of its heat resistance, and wear and friction properties. This was an eye-opener, because the gears segment was not a focus area for Alpha at that time. The organization allocated resources to exploring the gears segment. In Europe, an application development manager started looking into what value Alpha's product could bring in the gears segment and categorized applications. Additionally, Alpha's senior management provided resources to set-up a gears research program involving a mechanical engineer from corporate research. These two employees had regular contacts and also kept contact with several application developers in Asia and the U.S. They narrowed down the gears segment to automotive gears, where potential volumes are high. Initial application areas were motor management gears, engine gears, electronic power steering (EPS) gears, and interior gears[27]. After two years of internal research, Alpha employees began focusing more on collaborating with potential customers. This period marks the start of the *development* phase in 2005. In Europe, a business development manager was hired with expertise in the gears segment. Alpha managed to get their material on the short list of several tier one automotive suppliers that were active in gears

[27] Interior gears are gears that are used in interiors of vehicles, for example for adjusting seats.

projects. However, it appeared that it was difficult to deliver value over other materials in EPS gears and the interior gears applications, which resulted in decreased attention for these areas. In contrast, the organization had more success with motor management gears and engine gears applications. Alpha realized technical approvals with several tier one automotive suppliers that were working in these fields, which started the *commercialization* phase in 2007. After achieving commercial approvals, Alpha managed to introduce its high temperature plastic grade in several motor management gears and engine gears applications in 2008. At that same time, several additional developments in the gears area were ongoing.

In general, Alpha regards project *Gears* as a successful project. The product could be introduced into the market, and spin-off projects were realized. However, it was also argued that not all expectations could be realized because the number of applications where Alpha's material makes a difference is smaller than initially expected. The project fits the 'market-discontinuities' category because familiar technology was used to target new market applications. Table 6.22 presents project *Gears'* key characteristics with the corresponding case study evidence.

Table 6.22: Key characteristics Gears

Characteristics	Case study evidence
Category: *Market-discontinuity*	'...There was not that much collaboration with R&D because the material was fixed. There is no significant newness in the material...Specifically the applications are new' *Business development manager* '..in (Gears *ed.*) we use existing product grades....it is about new applications' *Marketing manager*
Investment level: *Medium*	'.....Our research program in wear and friction is backed by, let's say 100,000 Euro. Partly for gears, partly for other stuff' *Marketing manager* 'For this customer, I think we invested 25,000 Euro' *Business development manager*

Market learning

Project *Gears* was focused on a market segment (automotive gears), applications (EPS gears, motor management gears, engine gears, and interior gears) and customers (tier 1 automotive suppliers) that were all new to Alpha. Consequently, it had to generate and refine new market knowledge on these dimensions during the product innovation trajectory. In contrast, because Alpha's existing plastic grades were used it already had some product usage knowledge. It refined this knowledge during the product innovation trajectory.

Exploration and exploitation in market learning were combined over time and across dimensions. Sufficient market knowledge was generated and market knowledge integration occurred without any considerable problems (table 6.23).

Table 6.23: Market learning Gears

(phase) Knowledge dimension	(period) Learning Type	Case study evidence
(Initiation)	('03-'05)	
Segment	*Exploration*	'Initially, we wanted to get a feeling for the applications. What were segment trends and what were possible applications?' *Researcher* 'After some time we were able to distinguish three different application areas in the segment...We wrote these down and we just had to build up knowledge in these' *Business development manager*
Product	Exploitation	'I think the product line is still searching for the best market segments for their existing product grades...In this project, specifically the combination of heat resistance and wear and friction durability were the familiar building blocks to start with' *Researcher*
(Developm.)	('05-'07)	
Application	*Exploration*	'One of the major limitations was lack of application knowledge...we had to develop that by interactions with application-builders' *Researcher* '...after some development work we found that in a lot of EPS applications, our material was not easily accepted because there was often too little difference with competing materials that are cheaper' *Researcher*
Product	Exploitation	'We used known materials for these applications' *Business development manager* Existing grades are recommended for the (gears *ed.*) segment *Segment brochure*
Customer	*Exploration*	'You are active in a new segment, this means a lot of new customer contacts' *Researcher* 'If you only talk about (gears *ed.*), we learned that you not always get in touch with the right person at the buyers side...you have to talk about the whole actuator system' *Business development manager*
(Commerc.)	('07-'08)	
Application	Exploitation	'I also have a project at (customer *ed.*). In this project we worked together with the automotive OEM and the system supplier. We did all phases together and the vehicle will be introduced in 2010'. *Business development manager* 'in this application, we are working now on the commercial aspects. The customer wants to introduce the product in 2009' *Business development manager*
Product	Exploitation	
Customer	Exploitation	

Marketing function

An application development manager and business development managers played a central role in the market learning that took place via project *Gears*. These employees were marketing specialists because interacting with customers was part of their official task description. Although they were active in both exploration and exploitation their task focus was relatively high. They were totally dedicated to project *Gears* and were freed from other responsibilities. In other words, they were differentiated from the mainstream organization (table 6.24).

Table 6.24: Marketing function Gears

(phase; period) Marketing function	Case study evidence
(Initiation '03-'05) Application development manager	'...based on technical and market data, the application development manager who did some preliminary work had concluded that this was something we should try' *Business development manager* '...we have a world-wide team of marketing and technical people that are dedicated to (Gears *ed.*) *Business development manager*
(Developm. and commercialization '05-'08) Business development managers	'I am business development manager and I am solely focused on the gears segment' *Business development manager* 'Business development is in between sales and R&D. I communicate to R&D what the market wants and with marketing and sales I discuss expectations' *Business development manager* 'I worked together with the business development manager, who is in touch with the market' *Researcher*

Senior management involvement

Several senior managers of Alpha were involved in project *Gears*. They were present in the Global Product Team which consists of the business manager, the global marketing manager, the R&D manager and the product managers of the product line. Specifically the global marketing manager was involved as project sponsor. During initiation, senior management framed the search for new market knowledge by emphasizing the strategic choice to look into the gears segment and look for applications where existing plastic grades could fit. During development and commercialization, these managers employed a mixture of support and control. Support concerned facilitating project members by means of providing resources and freedom to be active in the project's day-to-day market learning activities. Senior managers controlled market learning by having discussions with project members on progress in market interactions and detecting deviations from original plans (table 6.25).

Table 6.25: Senior management involvement Gears

(phase; period) Senior management involvement	Case study evidence
(Initiation '03-'05) Framing	'The product line allocated people to look into the gears segment...' *Business development manager* '...to some extent, senior managers of the product line steer the business development managers' *Researcher* We aim to apply gear experiences from Asia in Europe and the U.S. *Analyst presentation Director Alpha 2004*
(Developm. and commercialization '05-'08) Support / Control	'In these projects, there is some risk involved, but I think that is part of the learning process. Senior management is aware of that and I have full support' *Business development manager* 'The product manager together with other senior managers allocate resources, based on criteria such as market volume and potential for multiplication....sometimes the product manager is also involved in project meetings to discuss progress' *Researcher* The global marketing manager is sponsor of the (gears *ed.*) project *Interview company magazine*

Market knowledge generation

During the initiation phase, segment knowledge was developed and product need knowledge was updated by using desk research and presenting at conferences to receive initial feedback on application ideas and get in contact with potential customers. In 2005, Alpha also partnered with an organization that provided an online intermediary environment, linking chemicals and plastics producers with downstream designers. With this organization they developed an online tool to get in contact and start co-development trajectories with potential customers. Other practices that were used in the development and commercialization phases were collaborations with potential customers for testing purposes. These collaborations generated product usage, application need, and customer knowledge. Additionally, market knowledge generation was accelerated by hiring a segment specialist (a business development manager) with experience in the gears segment (table 6.26).

Table 6.26 Market knowledge generation Gears

(phase; period) Market knowledge generation	**Case study evidence**
(Initiation '03-'05) Desk research / Conferences	'We researched trends in the market, for example EPS is a trend that was developing and is going to grow in the future...' *Researcher* 'We gathered information by visiting conferences' *Researcher*
(Developm. and commercialization '05-'08) Collaboration with potential customers / Hiring segment specialist / On-line tool	'In this application project we worked together with the system integrator (tier 1 automotive supplier *ed.*) and the automotive OEM and tested prototypes....With another customer we developed an alternative processing step' *Business development manager* 'We work together with tier 1 automotive suppliers to support their projects and try to influence their choice of material....' *Researcher* '..(Business development manager *ed.*) has a network in the gears world. That was really a useful addition' *Researcher* 'Myself, I have 20 years of experience in this world...' *Business development manager* 'This collaboration also includes a gear selector which is a unique interactive tool to assist gear designers with the first steps of material selection..... Thanks to their impressive coverage of the OEM and design engineering industry (online service provider *ed.*) offers a great solution to accelerate the growth of our business' *Marketing manager in press release collaboration with on-line service provider 2005*

Market knowledge integration

For project *Gears*, market knowledge integration in the initiation phase took place by an application development manager using his internal organizational network. The application development manager asked mechanical engineers in corporate research to work on the project. Later on, during the development and commercialization phases, market knowledge was mainly integrated by more formal recurrent project meetings involving different functional specialists. In some of these meetings, discussing prototypes and potential customer test results provided additional support for knowledge integration. Finally, the use of an organization-wide used cross-functional project implementation framework (i.e. PTO tool), which brought common language and awareness of

different responsibilities in different product innovation phases across the team, also supported market knowledge integration (table 6.27).

Table 6.27: Market knowledge integration Gears

(phase; period) Market knowledge integration	Case study evidence
(Initiation '03-'05) Internal organizational network	'Application development people from (Alpha *ed.*) approached corporate research with this application research project' *Researcher*
(Developm. and commcercialization '05-'08) Recurrent meetings / Prototypes / Implementation framework	'At the start of the project we had three to four meetings per year with the global team...Besides that we had local meetings related to specific applications...(Alpha *ed.*) and corporate research became very well connected' *Researcher* 'We analyzed actual gears, had test-programs and discussed results in the team' *Researcher* 'Test results from the customer were also discussed with people from research' *Business development manger* '(Alpha *ed.*) has a system, PTO, where all sub-projects are recorded. In this tool, different project phases are distinguished and progress is tracked' *Researcher* 'In this project we recorded our sub-projects in the PTO tool' *Business development manager*

6.5 Overall comparison

This chapter discussed findings on projects that fall into the 'market-discontinuities' project category. Based on the accumulated data from four cases, *Additive* (Theta), *Diffuse* (Sigma), *Bond* (Alpha), and *Gears* (Alpha), some similarities and differences between cases can be highlighted.

Similarities

In all four cases, project members searched for new application need knowledge, while leveraging and updating market knowledge on one or more of the other market knowledge dimensions.

What were the similarities in the marketing organizations that triggered and allowed project members to carry out this specific market learning behavior? First of all, in all four cases rather specialized marketing functions were involved in market learning (application/business development managers, marketing managers, and product managers). Additionally, the employees that carried out these functions were involved in both exploration and exploitation. In all four cases, the business unit's senior management tried to influence market learning by adopting multiple roles. In the initiation phase, these managers framed specific strategic areas to update or search market knowledge. They either identified and articulated already defined market segments as focus area or they emphasized searching for new segments and new applications where existing products could fit. In the development and commercialization phases of the product innovation projects, senior managers supported market learning by providing resources to the project members and acting as sounding board when necessary. Additionally, in all four cases the project members that performed the marketing function showed the skills to carry out desk research on market segments in the initiation phase of the projects and to develop collaborations with customers for testing purposes in

the later phases. Finally, in all four cases the organizational members that performed the marketing function were able to collaborate and interact with other participating functional specialists without any considerable problems in the development and commercialization phases of the product innovation projects. Because market knowledge integration happened without considerable problems in can be concluded that cognitive barriers between functional specialists that can hamper knowledge integration were successfully mitigated. Important practices used to develop a shared language and shared narratives were face-to-face meetings and discussing new product prototypes.

Differences

The overall comparison revealed small differences in organizational configurations between *Additive*, *Bond*, and *Gears*. These were specifically related to the practices in use to generate and integrate market knowledge. While project members in project *Gears* used an on-line tool to generate market knowledge in the later phases of the project, such a tool was not used in projects *Additive* and *Bond*. Considering market knowledge integration, employees involved in projects *Additive* and *Gears* made use of their internal organizational network in the initiation phase of the project. This practice was not used in project *Bond* because there was only one employee involved at the start of this project.

Larger differences could be observed when distinguishing between *Additive*, *Bond*, and *Gears* on one side and *Diffuse* on the other side. First of all, there was a difference in investment level. *Additive*, *Bond*, and *Gears* required a medium level of investment while *Diffuse* was in need of a low level of investment. Another difference relates to market learning behavior. While employees involved in *Additive*, *Bond*, and *Gears* focused on new directions on three market knowledge dimensions (segment, customer, and application need knowledge), employees involved in *Diffuse* focused on new knowledge on two market knowledge dimensions (customer and application need knowledge). In *Additive*, *Bond*, and *Gears* project members had to get familiar with market segments that were totally new to the organization while in *Diffuse*, project members acted within the borders of a familiar market segment. In the group of three cases, organizational members experienced the violation of their market segment frame of reference which forced them to admit the limits of prevailing understandings and practices. For example, the advice of consultants to look for other market segments in project *Additive*, and the realization of their product being used in several gears applications in project *Gears* triggered the identification of new potential market segments. A large part of these three projects consisted of just getting familiar with these newly identified market segments. As a researcher involved in project Gears put it:

> 'Specifically In the beginning we did not have developed ideas on gears or what they were. If you look at gears they look quite simple, but specifically the first years we really used to research what they could do. What are the specifics if you make them out of plastic? If you compare our material with steel it roughly has a factor 70 lower modulus and it is a factor 10 less strong. These are indications that you are in another stress-regime. This also implies that the functioning of plastic gears is different than the functioning of gears made out of steel. In the initial phases we really used the time to research…to get a feeling for applications and what is important. Where is our material successful and other materials

> fail……I have learned that it is really important to speak the same language as the application builders. They have to consider us as party that can offer added value…..So volumes of applications are important but not the only criterion. We also look for applications which we can use for multiplication, which we can use as 'sign' to attract other application developments'

This experience of identifying and learning about a completely new market segment could not be observed in project *Diffuse*. Additionally, several differences in the organizational configuration could be observed between the group of three cases and *Diffuse*. Senior management carried out control in the cases of *Additive*, *Bond*, and *Gears*, while limited control was carried out in *Diffuse*. It is likely that a reason for this was the difference in investment needs. Other important differences relate to the marketing function and market knowledge generation practices. Although in all projects the project members that carried out the marketing function were involved in both exploration and exploitation, a difference in focus could be observed between the group of three cases and *Diffuse*. In the group of three cases, employees responsible for the marketing function were totally focused on their specific project while their colleagues in *Diffuse* were also responsible for activities next to the project under study. In other words, the marketing function in the group of three cases was differentiated from the mainstream organization, while the marketing function in *Diffuse*, in contrast, was more integrated. Focusing on market knowledge generation practices an additional practice could be observed in the group of three cases when compared to *Diffuse*. While in the case of project *Diffuse*, employees solely relied on collaboration with a potential customer to generate market knowledge in the development and commercialization phases, the business units in the other three cases also added project members by hiring segment specialists.

7 Tech/market-discontinuities: Anti-resist, Foam, and Dye

This chapter describes the findings on cases that fall into the 'tech/market-discontinuities' category. In these projects, project members focused on market applications and technologies that were new to the organizations in which the projects were carried out. Successively, the chapter presents the findings on cases 'Anti-resist' (Beta), 'Foam' (Gamma), and 'Dye' (Gamma). Case descriptions are structured around the concepts that were presented in the conceptual framework in chapter 3. This chapter is concluded with an overall comparison.

7.1 Anti-resist (Beta)

Beta is a business unit of a multinational chemical company. It manufactures and sells a high performance fiber in product forms such as powder, pulp and filament yarn. Important end markets are automotive and defense industries. Companies in these end markets use Beta's materials to fabricate their own products which are sold to other companies, governments and the general public. Beta has offices and sales agents all over the world. In 2007, the business unit had several 100 million Euros in annual sales and employed about 1,000 people (table 7.1).

Table 7.1: Key numerical data Beta 2002-2007 (indices, 2002 = 100; based on annual reports)

Beta	2002	2003	2004	2005	2006	2007
Sales	100	124	145	158	173	181
Employees	100	107	110	115	125	130
R&D expenses	100	117	125	133	150	133

For application development and sales, Beta has organized eight globally operating sales/ marketing groups. Each of these groups targets a specific market segment with a set of product forms. Beta also has its own research department. Recently, the organization has set up a small marketing support function to develop and support cross-group marketing initiatives and innovation. Figure 5.2 presents a simplified organizational chart. Recently, Beta carried out project *Anti-resist*.

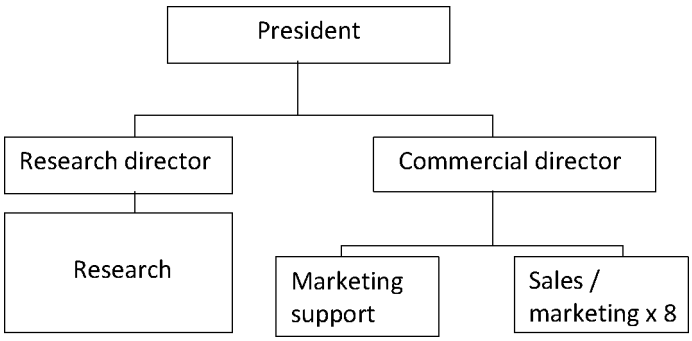


Figure 7.1: Simplified organizational chart Beta (based on interviews and Beta's website)

General outline of project Anti-resist

Project *Anti-resist* was mainly carried out by the research department and one of the eight sales/ marketing groups of Beta. The sales/marketing group focuses on the tire market where Beta's filament yarn is used as reinforcement material in cap plies of tires. As a project, *Anti-resist* was developed in Europe and required a medium level of investment. Significant research had to take place but no major plant adaptations were necessary. Beta decided to work with an external converter for manufacturing purposes for the first few years. The project fits the 'tech-market-discontinuities' category because unfamiliar technology was used to target a *new application* in the familiar tire market

In 2004, the sales/marketing group decided to do a market study on the future needs of the tire industry. This started the *initiation* phase of project *Anti-resist*. After some desk research and interviewing customers Beta employees found out that for the coming years tire manufactures aimed to contribute to lower fuel consumption by reducing the rolling resistance of tires. Meanwhile Beta's research department was focused on improving the bonding of filament yarn to rubber by treating it with chemicals. While the bonding was not significantly improved, the researchers found a way to improve the hysteresis properties of rubber compounds which, potentially, could reduce the rolling resistance of tires. After some *development* work in 2004 researchers generated chemically modified chopped fiber that could be mixed with rubber compounds and significantly reduced hysteresis properties. However, this product did not behave well on a larger scale. Further developments led to a granule variant of the product which was easier to handle in a manufacturing process. At the end of 2005, Beta started collaborations with several tire manufacturers to test the new product. Although the general feedback regarding reducing rolling resistance was positive, it appeared that some tire manufactures had difficulties using the product in their manufacturing process. This knowledge triggered the development of a second version of the product in 2006. The organization decided to simultaneously focus on the two product versions and project *Anti-resist* entered its *commercialization* phase in 2007. Beta started selling the first quantities in that same year. In 2008, larger tire manufacturers were still buying small quantities for further testing purposes. However, some smaller organizations already used Beta's product to produce bicycle tires.

In general, Beta regards project *Anti-resist* as a successful project. The product could be introduced into the market and several other tire manufacturers, besides the ones that were involved during development, showed interest and are testing the product. Table 7.2 presents project *Anti-resist's* key characteristics with the corresponding case study evidence.

Table 7.2: Key characteristics Anti-resist

Characteristics	Case study evidence
Category: *Tech/market-discontinuity*	'It is quite exciting, because it is a new application in an existing market segment, and we don't disturb our current application. We already sell yarn for reinforcing tires but now we are entering the business of modifying our product and mixing it with rubber. It is a compound, a marriage between the rubber and the fiber' *Business manager* 'In this project a new product with a new name is introduced into the market. Developing finishes for applications is our daily work, but developing a totally new product is something else.' *Researcher* 'Several elements are covered by patent applications' *Business manager*
Investment level: *Medium*	'Before we decided to set up our own manufacturing process (before 2007 *ed.*), investments were not too high. We already produced the yarn and we had to treat it with chemicals' *Business manager*

Market learning

Project *Anti-resist* was focused on a market segment (tires) and customers (tire manufacturers) that were already known to Beta. Consequently, it already had significant market knowledge on these dimensions at the start of the project. In contrast, because the product and the application were new to the organization, Beta had limited product usage and application need knowledge. It mainly had to learn about product usage and application needs by exploratory probes of prototypes in the market place during the development and commercialization phases of the project.

Exploration and exploitation in market learning were combined across market knowledge dimensions in the development phase and over time in the development and commercialization phases of the product innovation trajectory. Sufficient market knowledge was generated and market knowledge integration occurred without any considerable problems (table 7.3).

Table 7.3: Market learning Anti-resist

(phase) Knowledge dimension	(period) Learning Type	Case study evidence
(Initiation)	(2004)	
Segment	Exploitation	'We started looking into the tire industry, because we knew the tire industry and it is easy to look there...we already had relationships because we were familiar with the market ' *Business manager*
Customer	Exploitation	'We interviewed three of our existing customers in 2004, which are the biggest three in the market and cover about 65%, and asked them what their future needs were' *Business manager*
(Developm.)	('04-'07)	
Application	*Exploration*	'We learned that in compounding, tire manufacturers are using about 15 ingredients' *Business manager* '.....it occurred to us that rubber tires are complex compounds with several ingredients. It is not one product that is mixed with our product, and then there is also the way of mixing that can cause differences in test results' *Project manager* 'Product specifications were hard to pin down, because this product is also new for the customer. But they had certain expectations, which we could meet with our product' *Project manager*
Product	*Exploration*	'We made some experimental product which we could send to customers. We could say we are testing tires. I think we needed that because in lab tests you can have 20% improvement, but in practice you maybe have 10%. What is seen in the lab cannot be translated to the tires. So you need practical test and we do not build tires. We needed some tire companies that we could collaborate with' *Business manager* 'We faced some problems when testing, because at some customers the compound was not well dispersed, but we solved that' *Business manager* 'Very early on the (sales/marketing group *ed.*) wanted to confront customers with our prototypes, to get a market feedback. In the summer of 2005 we started delivering prototypes to them...This resulted in feedback that triggered the development of a new type of the product' *Researcher* 'We tested our prototype product with customers and they thought it was attractive. However they also discovered some limitations. Based on that feedback we adapted the product and it is expected that this is going to be the main product type' *Project manager*
Customer	Exploitation	'Earlier we called the product 'modified fiber'. However we found out that the fiber people at our customers did not really understand the product. They told us we had to go to the materials groups of these companies' *Business manager* 'We knew that tire manufacturers do not like working with chopped fiber because it is hard to mix...so we had to take some steps there' *Researcher*
(Commerc.)	(2007)	
Application	Exploitation	'We commercialized our new product in this application with some partners and now (2008 *ed.*) we are trying to build that out' *Business manager*
Product	Exploitation	'To some extent we have frozen our end product and are in the middle of the market introduction phase at the moment. We have some commercial production for producers of bicycle tires, but manufacturers of car tires are doing fleet tests at the moment and buy several hundred kilos for that. But they are still on board and have provided us with positive feedback' *Project manager*
Customer	Exploitation	

Marketing function

The central role in market learning in project *Anti-resist* was mainly carried out by a sales manager from the sales/marketing group. When *Anti-resist* started, this sales manager was part of the elastomer reinforcement group. However, during the development phase the employees that focused on tires split off from this group and Beta established a specific tires group headed by the sales manager. So when the sales manager became business manager of the tires group and had to spread his attention, he was supported in market learning for project *Anti-resist* by several sales managers working in the tires group.

All employees that carried out the marketing function in the project could be considered marketing specialists because interacting with customers was part of their official task description.

The task focus of the tires business manager and sales managers was relatively low. They were involved in both exploration and exploitation and had other tasks next to *Anti-resist* such as selling filament yarn for tire reinforcement. In other words, project *Anti-resist's* marketing function was highly integrated in the mainstream organization (table 7.4).

Table 7.4: Marketing function Anti-resist

(phase; period) Marketing function	**Case study evidence**
(Initiation, 2004) Sales manager	'At the start of the project I was account manager, which is a technical sales function for tires worldwide…so I sell yarn, but I was also involved in this project. The marketing and commercial part is done by me' *Business manager* 'Market feedback was provided by (sales manager *ed.*) *Researcher*
(Developm. and commerc. '04-'07) Business manager / Sales managers	'In 2005, the tire department was founded. They gave me full responsibility of tires, including commercial responsibility' *Business manager* '(Business manager *ed.*) had direct contacts with customers and found the partners which we used for testing…He is responsible for the tires (sales/marketing group *ed.*) and has several sales colleagues who can help out' *Project manager*

Senior management involvement

The senior managers of Beta were, to some extent, involved in the market learning of project *Anti-resist*. During initiation, they framed the search for new market knowledge by emphasizing the strategic choice to look for new applications in existing market segments. During development and commercialization, they supported project members by allocating human and financial resources. However, they also controlled market learning. Project members had to report regularly on project progress and market feedback and a specific high level steering committee was established to track progress during development and commercialization (Table 7.5).

Table 7.5: Senior management involvement Anti-resist

(phase; period) Senior management involvement	**Case study evidence**
(Initiation, 2004) Framing	'In the past we were sold out, but now we are expanding and we also need the future to be bright, so senior management encourages us to look for new applications in our market segments' *Business manager* 'Our strategy is to see the application area as wide as possible. Here we see a difference with our direct competitor which seems to focus on high margin applications' *Business manager (of other sales/marketing group)*
(Developm. and commercialization '04-'07) Support / Control	'All along there was the support of the management of the company' *Business manager* 'We always have budgets to initiate new things' *Business manager* 'In the steering team meeting higher management is involved, like VP R&D and VP commercial, which is my boss. Here we discuss large investments. So investments for the plant are discussed there. I provide input by presenting the progress of the project' *Business manager* 'The lines in our organization are short. (Business manager *ed.*) can easily contact his boss and my boss is also involved in the project. Specifically in the later phases of the project, people from the management team even had direct contact with me if they wanted to ask a question' *Researcher* 'This project is supported, I can hire more people, but I like working with a small group' *Business manager* 'Next to the project meeting and steering team meeting we have another meeting with top management where we talk about what we need for the coming year. Here you discuss the subjects that you are working on and is decided if you receive budgets to continue' *Business manager* 'There is support, certainly, but in the later phases of the project, when they started building the plant, control was increased' *Researcher* 'Without a doubt, top management supported us and was not afraid to take some risks' *Project manager*

Market knowledge generation

In the initiation phase of project *Anti-resist*, market knowledge was updated by doing desk research and visiting customers. In the development and commercialization phases, market knowledge was mainly generated and updated by collaborating with potential buyers to test prototype products (table 7.6).

Table 7.6: Market knowledge generation Anti-resist

(phase; period) Market knowledge generation	**Case study evidence**
(Initiation, 2004) Desk research / Visiting customers	'We interviewed three of our customers in 2004, which are the biggest three in the market and cover about 65%, and asked them what their future needs were' *Business manager* 'I can show you the figures. Here you see that rolling resistance is an important customer concern. You see that it is going on until 2012. This is based on the interviews with customers and desk research' *Business manager* 'Based on desk research (sales/marketing group *ed.*) made rough calculations of the market potential very early in the project' *Researcher*
(Developm. and commercialization '04-'07) Collaboration with customers	'We collaborated with a number of customers, using a secrecy agreement. We had our prototypes and asked them to have a look at them....we already tested the product on lab-scale but then we could say we were testing tires' *Business manager* 'We did tests with customers. A lot of the lab results were confirmed by customers' *Researcher*

Market knowledge integration

For project *Anti-resist*, market knowledge integration in the initiation phase occurred by employees making use of their internal organizational network. Later on, during development and commercialization, recurrent team meetings were used, and prototypes were discussed. The team also used a cross-functional project implementation framework which is known throughout the organization. The use of this framework resulted in common language and awareness of different responsibilities across the team. This provided additional support for market knowledge integration (table 7.7).

Table 7.7: Market knowledge integration Anti-resist

(phase; period) Market knowledge integration	**Case study evidence**
(Initiation, 2004) Internal organizational network	'At the start it was not a separate project and there was no management involved. I had talks with our research institute and they took a look at it. There was no separate budget and no project formulated' *Business manager* 'Research and (sales/marketing group ed.) got together and decided to work on this rolling resistance issue' *Researcher*
(Developm. and commercialization '04-'07) Recurrent meetings / Prototypes / Implementation framework	'We have what we call a project team meeting every six weeks to keep everyone on the same page. Nowadays it is sometimes 12 people involved. We have manufacturing, research, marketing, and the project coordinator' *Business manager* 'I worked together with the sales manager from (sales/marketing group *ed.*)...we had official meetings but also informal contacts' *Researcher* 'We discussed the granule prototype with (sales/marketing group *ed.*) and they told us it looked good, because the tire industry is used to working with granules. A lot of powders are granulated because powders give dust' *Researcher* 'We have project team meetings where we sit together with marketing, research, logistics, purchasing, and manufacturing...working together never was a problem' *Project manager* 'We also use a project management tool. You have different phases such as exploratory phase, development, and commercialization...This framework also includes stage-gate checklists. We used that to structure our discussions in the team' *Business manager*

7.2 Foam (Gamma)

Gamma is part of a large multinational company. It primarily manufactures and sells a large variety of plastic resins and compounds. Important end markets are the automotive, electrics and electronics (E&E), and building industries. Companies in these end markets use Gamma's products to fabricate products which are sold to other companies, governments and the general public. Gamma has R&D departments, manufacturing plants, and sales organizations all over the world and its history can be traced back to the 1930s. In 2006 the business unit had around 5,000 million Euros in annual sales and employed about 11,000 people (table 7.8).

Table 7.8: Key numerical data Gamma 2002-2007 (based on annual reports)

Gamma	2002	2003	2004	2005	2006	2007
Sales (mln. Euro)	3,853	3,850	4,462	4,858	4,859	5,100
EBIT (operating profit)	619	310	416	638	493	n.a.
EBIT/sales ratio (%)	16.1	8.0	9.3	13.1	10.1	n.a.
Employees	n.a.[#]	n.a.	10,000	10,000	11,000	11,000
R&D expenses (mln. Euro)	100	100	100	110	105	103
R&D/sales ratio (%)	2.6	2.6	2.2	2.3	2.2	2.1

[#] n.a. = not available

Gamma has organized its activities in a matrix. Product technology (i.e. research) and product management operates globally while sales, including technical support and application development, has a regional scope. Additionally, there is a separate global marketing organization which includes a global application technology department. Figure 7.2 presents a simplified organizational chart. Recently, Gamma carried out project *Foam*.

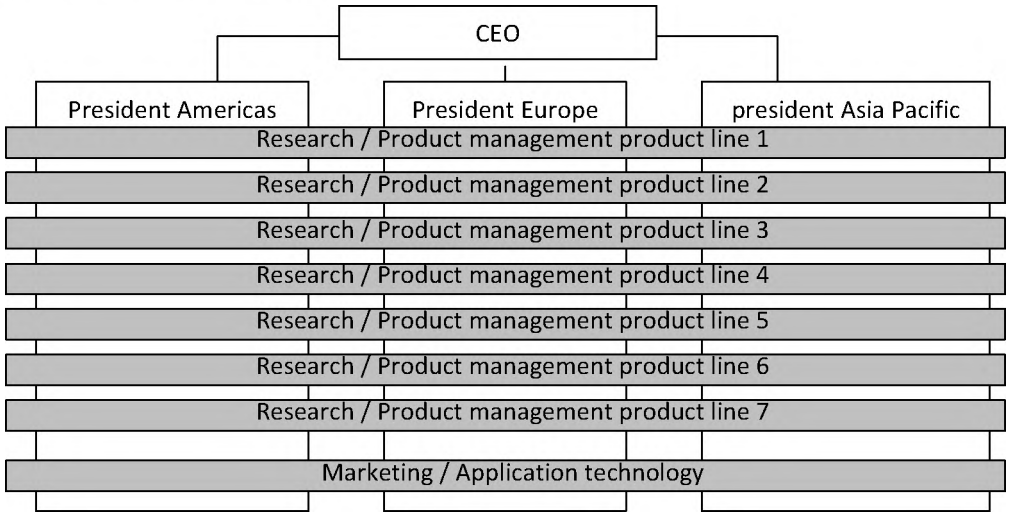


Figure 7.2: Simplified organizational chart Gamma (based on interviews and company presentations)

General outline of project Foam

Project *Foam* was mainly carried out by the global marketing department of Gamma involving employees from the United States and Europe. It required a high level of investment because Gamma had to invest several millions of Euros in a new production line. The project fits the 'tech-market-discontinuities' category because unfamiliar technology was used to target new applications.

Before 2005, Gamma provided a high performance plastic resin to a company that turned this resin into high performance foam which was mainly used as core material in structural components of commercial and military aircraft interiors. Product features that were specifically valued were its forming and fire properties and its radar transparency. In 2005, the foam producer decided to phase out producing the foam and withdraw from the market because of restructuring reasons. Gamma offered to help keeping their foam product in service but was unable to persuade them. Because foam businesses have higher margins than resin businesses Gamma started analyzing if it made sense to produce and sell the foam by itself. This started the *initiation* phase in 2005. In 2006, the decision was made to develop an own foam material and *development* starts. In October 2006 Gamma bought manufacturing equipment and started developing the foam production line in their global application technology department in the United States. In parallel, it identified six aircraft interior manufacturers as validation partners based on their use of the current material. These were all existing customers that already bought several resin types from Gamma. The business unit managed to collaborate with these partners for testing purposes as it moved through the development phase. Gamma also did put efforts in getting their new material qualified by aircraft builders. By 2008, Gamma had managed to scale up the manufacturing process to a certain extent. Project *Foam* entered the *commercialization* phase when team members started looking for distribution partners. Gamma had decided that it was going to manufacture the foam in three standards sizes. Because potential customers could order a wide variety of sizes the organization needed distribution partners that had a specific sawing capability. For Europe such a partner was found in the United Kingdom. After developing an internal order handling system, the first commercial orders were received by the end of 2008.

In general, Gamma regards project *Foam* as a successful project because the product could be introduced into the market. However, because technical developments took longer than expected the market introduction was delayed by almost a year. Additionally there was some confusion on roles and responsibilities in the commercialization phase. The marketing organization started contacting potential customers and distributors in Europe without involving the local sales people. This also might have caused some delay. Table 7.9 presents the key characteristics of project *Foam* with the corresponding case study evidence.

Table 7.9: Key characteristics Foam

Characteristics	Case study evidence
Category: *Tech/market-discontinuity*	'At the start of the project we did not sell high performance foam' *Sales manager* 'We have some patent applications filed for our process....The newness is in the conversion technique. It is a completely different production process as (original foam producer *ed.*) uses. They use a batch process, our process is continuous' *Project manager* 'This is a new application for us, we already sell resins to (aircraft interior manufacturers *ed.*) but these are used in other applications...we did not sell products that are used as core-products in aircraft interiors. It is really a new market space for us. Actually we developed a whole new platform' *Marketing manager*
Investment level: *High*	'In 2006 we got the approval for the technical program. Senior management basically said: here is 5 million dollars, go and do it' *Marketing manager* 'Global marketing also had to look into other foam applications, because buying the production line required high investments' *Sales manager*

Market learning

Project *Foam* was focused on customers (aircraft interior manufacturers) that were already known to Gamma. Consequently, it already had significant market knowledge on the customer dimension at the start of the project. In contrast, at the start of the project Gamma had little product usage (new foam product), market segment (high performance foam), and application need (cores of aircraft interior components) knowledge.

Exploration and exploitation in market learning were combined across market knowledge dimensions in the initiation and development phases and over time during the development and commercialization phases. Sufficient market knowledge was generated. Apart from the confusion related to roles and responsibilities in the commercialization phase, market knowledge integration occurred without any considerable problems (table 7.10).

Table 7.10: Market learning Foam

(phase) Knowledge dimension	(period) Learning Type	Case study evidence
(Initiation)	('05-'06)	
Segment	*Exploration*	'At the start of the project we did not sell high performance foam' *Sales manager* 'Global marketing looked at volumes and prices and market expectations. They also had to look at what are other opportunities for foam' *Sales manager* 'At the start of the project we quantified the market and identified certain applications for this material. So we had some comfort level of what the market really was. The investments were based on a multigenerational plan which included analyses on different applications in the high performance foam market. We studied market reports on high performance foam and where it was used' *Marketing manager*
Customer	Exploitation	'I was in contact with (aircraft interior manufacturers *ed.*) and they were concerned because (original foam producer *ed.*) told them they were planning to stop producing foam. I fed this information back into the organization. I gave the specific commercial input' *Sales manager* 'The reality is that customers who use our thermoplastics for injection molding are also potential customers for the foam form as well. So we know all of them and the contacts were already there' *Marketing manager* 'From a commercial view, first question was analyzing the reactions of customers of the incumbent material to the situation. Were they designing out the material? Were we chasing a market space that was getting smaller because customers were phasing out this material, or was it that they lost business because they couldn't continue what they needed to do' *Marketing manager*
(Developm.)	('06-'08)	
Application	*Exploration*	'With the individual validation partners I moved from a market segment level to an application level... I gathered the customer needs and continuously kept customers informed and involved throughout the program' *Marketing manager* 'I have been active in handling customer needs in order to qualify this material. We acquired the specs of the validation customers and made sure that the product hit their requirements' *Project manager*
Product	*Exploration*	'The type of discussions we had with customers was completely different than what we normally have. It is not an injection molding material. We did not talk about mold temperature, conditions of raw materials or flow lines' *Marketing manager* 'Working with several validation partners was quite important. They tested initial prototypes of the material to see if it would meet their set of requirements and fed their experiences back to us.....We were open to them, showing them how we developed it and the different test methods that we used' *Marketing manager*
Customer	Exploitation	'During the development phase I got in close contact with the foam people at our customers' *Marketing manager*
(Commerc.)	(2008)	
Application	Exploitation	'In the scale-up phase of the technical innovation we produced the foam on the actual manufacturing equipment and validated that with the validation partners. Besides that, we started the commercial implementation. We looked for a distributor and introduced this organization to the customers to make sure they were comfortable with the distributor' *Marketing manager* 'We completed developing one of the three grades last September (2008 *ed.*) customers are now doing final qualifications' *Project manager*
Product	Exploitation	
Customer	Exploitation	

Marketing function

The central role in market learning in the initiation phase of project *Foam* was mainly carried out by a U.K. sales manager and a marketing manager located in The Netherlands. During the development phase this role was primarily in the hands of marketing managers of the global marketing organization. When the project was in the commercialization phase, eventually, several regional sales managers were added.

All functions that carried out this central role were marketing specialists in a sense that interacting with customers was part of their official task description.

The task focus of the employees that carried out the marketing function was relatively high. Although all employees involved had additional sales tasks or other projects next to project *Foam* they were either concentrating on the exploration part or the exploitation part of the of market learning in the course of project *Foam*. Hence, exploration and exploitation in market learning were carried out by different employees. For example, in the initiation phase the regional sales manager came with the feedback from the aircraft interior manufacturers that the foam company planned to phase out high performance foam production (exploitation), while the marketing manager was involved in exploring the high performance foam segment (exploration). Because the marketing manager was solely focused on exploration and was not responsible for routine activities of the mainstream organization it is fair to say that, for project *Foam*, the overall marketing function was relatively differentiated from the mainstream organization (table 7.11).

Table 7.11: Marketing function Foam

(phase; period) Marketing function	**Case study evidence**
(Initiation '05-'06) Sales manager / Marketing manager	'I am the commercial manager for Ireland and the United Kingdom. I am responsible for the commercial success of our products in this area...I did this project next to other projects. It was part of my daily job' *Sales manager* 'I was in contact with (aircraft interior manufacturers *ed.*) and they were concerned because (original foam producer *ed.*) told them they were planning to stop producing foam. I fed this information back into the organization. I gave the specific commercial input' *Sales manager* 'My responsibility is to develop a strategy for composites in the transportation market within (Gamma *ed.*). We talk in general terms about composites as being honeycomb materials, prepreg materials, and foams.' *Marketing manager* 'For the business case I worked with my marketing colleagues to define the market space and pitched that to our higher management' *Marketing manager*
(Developm. '06-'08) Marketing managers	'In this project, global marketing was taking the project through development as well, I was not so much involved in that phase' *Sales manager* 'With the individual validation partners I moved from a market segment level to an application level... I gathered the customer needs and continuously kept customers informed and involved throughout the program' *Marketing manager*
(Commerc. 2008) Marketing managers / Sales managers	'I became involved again when we were getting to commercialization last year. We had a product and a timeline for having a commercial product. Together with (marketing managers *ed.*) I identified the customer base and developed a supply chain solution for the material' *Sales manager* 'In partnership with the distributor I went to the end-customer to make sure that they had the confidence that the intermediate partner was technically and commercially capable of providing the material' *Marketing manager*

Senior management involvement

The senior managers of Gamma's global marketing organization and the top management team of Gamma were, to some extent, involved in the market learning that took place via project *Foam*. During initiation, they framed the search for new market knowledge by emphasizing the strategic choice to look for new market segments beyond segments where plastics pellets were sold and injection molding was the key processing technology, such as fibers and foams. Before *Foam* started, senior management already allocated resources to a 'new market segment' group operating in the global marketing organization which had to implement this strategic intent. During development and commercialization, senior managers supported project members in their market learning efforts by allocating resources. However, in these phases they also controlled market learning. Project members had to collect lots of market data before the investments for the new production line were approved. Additionally they had to report regularly on project progress and market feedback (Table 7.12).

Table 7.12: Senior management involvement Foam

(phase; period) Senior management involvement	**Case study evidence**
(Initiation '05-'06) Framing	New markets group is focusing, among other things, on high performance foam *Company presentation 2007* 'Foam was always on our mind. There was always the idea, should we do that. We knew it was a value added process. But there is also the golden rule, don't compete with your customers' *Marketing manager* 'It is our long term strategy to look into our resin portfolio and develop new products based on downstream manufacturing processes such as films, foams, and fibers, which allow us to focus on new markets' *Marketing director* 'There is a strategy about innovating our current plastic resins, and there is a strategy to go beyond injection molding if you will' *Project manager*
(Developm. and commercialization '06-'08) Support / Control	'In 2006 we got the approval for the technical program. Senior management basically said: here is 5 million dollars, go and do it' *Marketing manager* 'Back in 2006, we identified a XX mln. aircraft interior market, but that was not enough for senior management to go ahead. We needed to deliver a plan which included data on more applications' *Marketing manager* 'Every three or four months I provide an overview of the status of all my projects to the top management of the organization, and I also have to choose one project for an in-depth presentation...there we have the dialogue on progress'. *Marketing Manager* 'Selection criteria to start the project were a combination of economics, ROI and IRR, and demonstrating a small lab-scale size...reporting goes through marketing to the CEO of the company' *Project manager* 'We had acceptable levels of funding during project implementation' *Project manager*

Market knowledge generation

In the initiation phase of project *Foam*, customer knowledge was updated and segment knowledge was developed by doing desk research and talking with customers. Additionally, organizational members used an explicit step-by-step framework which is used throughout Gamma's marketing organization to map the foam market segment. In the development and commercialization phases, market knowledge was mainly generated and updated by collaborating with customers for testing

prototype products. Collaborations were established with downstream product specifiers (i.e. aircraft interior manufacturers and aircraft builders) and a distributor which adds value by customizing the foam to customer specifications (table 7.13).

Table 7.13: Market knowledge generation Foam

(phase; period) Market knowledge generation	**Case study evidence**
(Initiation '05-'06) Desk research / Visiting customers / Using Framework	'For developing the business case, we studied market reports to get familiar with the market space and with applications...you can buy market reports on high performance foam and where that goes into' *Marketing manager* 'I was in contact with (aircraft interior manufacturers *ed.*) and they were concerned because (original foam producer *ed.*) told them they were planning to stop producing foam. I fed this information back into the organization. I gave the specific commercial input' *Sales manager* 'From a commercial view, first question was analyzing the reactions of customers of the incumbent material to the situation. Were they designing out the material? Were we chasing a market space that was getting smaller because customers were facing out this material, or was it that they lost business because they couldn't continue what they needed to do' *Marketing manager* 'In global marketing, we follow a framework, also at the start of the project. We have a specific market assessment phase before we present the business case to senior management. Within that framework there is a whole series of tools available' *Marketing manager*
(Developm. and commercialization '06-'08) Collaboration with customers	'Working with several validation partners was quite important. They tested initial prototypes of the material to see if it could meet their set of requirements and fed their experiences back to us....We selected six validation partners which went with us through the development phase. We were open to them, showing them how we developed it and the different test methods that we used' *Marketing manager* 'I would say commercially we did a very good job, we selected six validation customers which was enough to hit most of the requirements, and they are all buying different grades. We dealt with them with a fair amount of personal contact' *Project manager*

Market knowledge integration

For project *Foam*, market knowledge integration in the initiation phase occurred by organizational members making use of their internal network. The sales manager contacted the global marketing organization to see if something could be done to help out the aircraft interior OEMs concerning their foam supplier phasing out a product that they needed. Later on, during development and commercialization, recurrent team meetings were held and prototypes were discussed. The team also used a cross-functional development framework which is known throughout the organization. The use of this framework resulted in common language and awareness of different responsibilities across the team. This provided additional support for market knowledge integration. However, market knowledge integration was also hindered by lack of interaction between the global marketing organization and the U.K. sales manager at the start of the commercialization phase (table 7.14).

Table 7.14: Market knowledge integration Foam

(phase; period) Market knowledge integration	Case study evidence
(Initiation, '05-'06) Internal organizational network	'I fed this information (customer information *ed.*) back into the organization. I gave the specific commercial input by connecting with the global marketing organization and the product management organizations' *Sales manager* 'When initiating the project I worked fairly solo, although I had some ad-hoc meetings with some colleagues' *Marketing manager*
(Developm. and commercialization '06-'08) Recurrent meetings / Prototypes / Implementation framework	'Except for the beginning of the project there was always a project team involved' *Marketing manager* 'Most of the folks are based in the U.S., at least from the technical side. We get together fairly regularly. Globally, we have monthly core team (app. technology, marketing, sales *ed.*) calls....Together with the European folks I went to possible distribution partners' *Project manager* 'One of the challenges we faced was related to roles and responsibilities. Later in the project, global marketing contacted customers in the U.K. without my knowledge. That caused some friction because that influences sales projections in a country' *Sales manager* 'Not everything went perfectly during commercial validation. We (global marketing *ed.)* had to communicate across different continents and there were times that we did not communicate directly with the field people (sales *ed.*). When they tried to pick up responsibility and talked to the validation partners they found out things we told the validation partners but did not communicate to them' *Marketing manager* 'As a team we discussed the validation program and prototypes of the technical feasibility phase before we started working with external validation partners' *Project manager* 'Our team followed a formal process that is used in the organization, with different gates and milestones...are we on track cost wise, time wise, performance wise, all those things are mapped' *Marketing manager* 'We used the process framework that is in place in the organization....a phase-gate system to carry out project work' *Project manager*

7.3 Dye (Gamma)

Just as project *Foam*, project *Dye* was carried out by Gamma. Therefore this section will leave out the description of the business unit and will start directly with the general outline of project *Dye*.

General outline of project Dye

Project *Dye* was a joint effort of the global marketing department, the sales organization and a product line of Gamma and was carried out in Europe. It required a medium level of investment. Gamma had to develop a new product and invest in studying a new market segment. However, no substantial investments in manufacturing facilities had to take place. The project fits the 'tech-market-discontinuities' category because unfamiliar technology was used to target a new application.

In 2003, the corporate research department of the multinational owning Gamma invented a dye that had a specific glow under UV light and blended well with plastic resins. The corporate research department approached Gamma to see if there was an interest from their side. Gamma decided that the research project was worth investing in because the organization was working on developing an anti-counterfeiting solution to prevent illegal CD and DVD copying. This new dye had the potential to

fit in this development. The new dye also triggered the idea to look at other anti-counterfeiting solutions. Gamma decided to appoint a marketing manager from global marketing to take a first look at this newly identified market segment. This started the *initiation* phase in 2005. After a year of market research, the marketing manager identified five potential applications for the new dye in the anti-counterfeiting market segment. Gamma decided to focus on spirits anti-counterfeiting as launching application area such as the introduction of self-made whiskies under an established brand name. Among other things this choice was based on the fact that Gamma was already selling plastic resin to bottle caps and closures manufacturers that operate in this field. The idea was that downstream manufacturers would produce caps of spirits bottles for brand owners with Gamma's plastic resin which included the new dye. Downstream stakeholders, such as spirits wholesalers and customs could identify if they were dealing with 'the real thing' if they shined with an UV lamp on the plastic caps. The *development* phase began when Gamma started collaborating with a European caps and closures manufacturer that showed interest in the anti-counterfeiting solution. Gamma delivered the complete system (i.e. plastic resin pellets with newly developed dye) and the caps and closures manufacturer started in-house testing at the end of 2006. When opening a bottle of spirits, the cap had to break from the neck of the bottle. However, it appeared that Gamma's resin was to strong and the bottles were very hard to open. Based on this feedback, Gamma aimed to make its plastic resin less strong. In March 2007, the caps and closures manufacturer tested the adjusted product. Results were slightly better but inconsistent. Some bottles could be easily opened but other bottles were much harder to open. At the same point in time, Gamma's marketing manager came across a representative from a whisky brand owner that bought caps from Gamma's validation partner. This representative was enthusiastic about Gamma's solution, contacted the caps and closures manufacturer and expressed interest. Additionally he advised Gamma's marketing manager to investigate if the dye blended well with the plastic resin that was already in use to produce the caps. If this was the case, he assured that validation trajectories, and therefore implementation, would go faster. This new direction changed the internal organization of the project. The plastic resin that was already in use for producing caps was not a plastic resin that was manufactured and sold by Gamma. Therefore, the marketing manager stopped working together with the plastic resin product line and started working with the product line that (externally) buys plastic resin and has compounding as main activity. Because of lack of collaboration between Gamma's color technology group and their compounding product line, some problems arose in identifying the color that matched the color that was used for the whisky bottles of the brand owner. After solving this problem, Gamma's validation partner (i.e. caps and closures manufacturer) continued testing Gamma's solution. The new variant passed several rounds of testing and the *commercialization* phase started in 2008. First sales could be realized at the end of the same year.

In general, Gamma regards project *Dye* as a successful project. The product could be introduced into the market and some spin-off projects could be started. However, during development there were some difficulties regarding collaboration between different departments within Gamma, which had a negative impact on project efficiency. Table 7.15 presents the key characteristics of project *Dye* with the corresponding case study evidence.

Table 7.15: Key characteristics Dye

Characteristics	Case study evidence
Category: *Tech/market-discontinuity*	'I am working as marketing manager for this industry that is a new domain for us: anti-counterfeiting solutions. It is kind of an industry but it covers other traditional industries because you can have solutions for, for example, automotive, spirits, electronics…It also includes a new technology. The dye that we use is new, it turns bright yellow under UV light which is difficult to achieve. It is developed and patented by us' *Marketing manager* 'We never used this product (dye *ed.*) before because it was recently developed' *Sales manager* 'The dye is hard to copy because we patented this new technology' *Researcher*
Investment level: *Medium*	'We had to invest in developing the technology and researching the market. We buy the resin from an external company and an external company manufactures the pigment. So we have these separate components coming and our product line compounds and blends everything together and delivers pellets to the customer' *Marketing manager*

Market learning

Project *Dye* was focused on a customer (caps and closures manufacturer) that was already known to Gamma. Consequently, Gamma already had significant market knowledge on the customer dimension when initiating the project. In contrast, at the start of the project Gamma had little product usage (resin with newly developed dye), market segment (anti-counterfeiting market), and application need (spirits anti-counterfeiting) knowledge.

Exploration and exploitation in market learning were combined across market knowledge dimensions in the initiation and development phases and over time during the development and commercialization phases. Sufficient market knowledge was generated. Apart from the lack of collaboration between two of Gamma's departments during development, market knowledge integration occurred without any considerable problems (table 7.16).

Table 7.16: Market learning Dye

(phase) Knowledge dimension	(period) Learning Type	Case study evidence
(Initiation)	('05-06)	
Segment	*Exploration*	'In 2005 I started to work on this project. The first year I really did a lot of background research...trying to understand what were the problems, what were the needs. Studying diverse traditional industries, just trying to understand this big thing, this counterfeiting. Could we do something and could we make money there? Where there market spaces where people use plastics and have these problems?...Although we work with a variety of customers it was not a question that we asked before. But if you ask them 'do you have a problem with counterfeiting?'...a lot of them have, it is amazing' *Marketing manager* 'The marketing manager explained to us (sales managers *ed.*) in which area to dig for new opportunities' *Sales manager*
Customer	Exploitation	'We (sales managers *ed.*) went to several of our existing customers and found out that (caps and closures manufacturer *ed.*) had an interest...one of our technical sales guys is following this company for a long time, he knows about their production and machinery' *Sales manager* 'I tried to see what we could do with existing customers, because we know them and it is easy to talk with them. We have this big commercial organization and I used the technical sales managers as entry point. I went with them to customers and presented that this (anti-counterfeiting *ed.*) was something we were working on' *Marketing manager*
(Developm.)	('06-'08)	
Application	*Exploration*	'I learned from (whisky brand owner *ed.*) that if we wanted to start something quickly, we should not change anything to the resin that was already in use in this application. If we changed something, the (whisky brand owner *ed.*) would have to revalidate its bottling process' *Marketing manager* 'When working together, (caps and closures manufacturer *ed.*) agreed that using the same plastic resin that they were already using made them feel more comfortable' *Sales manager*
Product	*Exploration*	'(Caps and closures manufacturer *ed.*) tested our first prototype product. They contacted us and said, works fine, we can mould caps and it glows under UV light, but the thing is we cannot open the bottles. So that was back to the drawing board for us' *Marketing manager* 'We had several rounds of testing at (caps and closures manufacturer *ed.*) to see if proper caps could be made and the product behaved as in our lab. You have to be very open to customers on that. You have to present some internal data to build confidence but also emphasize that you have to discover things together' *Sales manager*
Customer	Exploitation	'We followed two parallel lines. First we dealt with the technical guys of the company (caps and closures manufacturer *ed.*), but later we also talked to their purchasing and sales department to make sure we had the ok of various stakeholders at (caps and closures manufacturer *ed.*)' *Sales manager*
(Commerc.)	(2008)	
Application	Exploitation	'After we had established that the product worked properly, we entered a phase of fine-tuning the product. It is about how much dye we should apply to get the result the customer wanted' *Sales manager*
Product	Exploitation	'After the formulation was frozen, the customer had to decide what color intensity they wanted to buy' *Researcher*
Customer	Exploitation	' After the last trials, (caps and closures manufacturer *ed.*) made some industrial parts that were shipped to (whisky brand owner *ed.*) along with a price proposal, we also received a feedback on their reaction' *Marketing manager*

Marketing function

The central role in market learning in the initiation phase of project *Dye* was mainly carried out by a marketing manager and several sales managers located in Europe. During development and commercialization, this role was primarily in the hands of the same marketing manager and one sales manager.

These marketing manager and sales managers were all marketing specialists in a sense that interacting with customers was part of their official task description.

The task focus of the employees that carried out the marketing function was relatively high. Although the employees involved had additional sales tasks or other projects next to project *Dye*, they were mainly concentrated on either the exploration part or the exploitation part of market learning in the course of the project. For example, in the initiation phase the marketing manager developed new segment knowledge (i.e. exploration) while the sales managers updated their customer knowledge (i.e. exploitation). Because the marketing manager was solely focused on exploration and was not responsible for routine activities of the mainstream organization it is fair to say that the overall marketing function in project *Dye* was relatively differentiated from the mainstream organization (table 7.17).

Table 7.17: Marketing function Dye

(phase; period) Marketing function	**Case study evidence**
(Initiation '05-'06) Marketing manager / Sales managers	'The marketing role in this project could not easily be done in a product line. Because it was vague: a lot of traditional industries and across plenty of product sites. Because it is so broad you cannot ask anyone in one product to work on it or anybody in the field to focus on it. So we decided to put a special resource behind it, being me, to look at it. I have several projects where I focus on this new segment' *Marketing manager* 'In 2005 I started to work on it. The first year I really did a lot of background research...trying to understand what were the problems, what were the needs. Studying diverse traditional industries, just trying to understand this big thing, this counterfeiting...At the start I visited about 20 customers covering 5 to 6 traditional industries together with several sales colleagues who work in the field' *Marketing manager* 'My main task is defining existing and new customers where we can position our existing products. When we have developed something new, as in this project, we work with a marketing manager. I introduce him or her to the customer. They bring the extra knowledge...I did this project next to my other work' *Sales manager*
(Developm. and commercialization '06-'08) Marketing manager / Sales manager	'We had several meetings with (caps and closures manufacturer *ed.*) during the validation process. Additionally, when a prototype got tested someone from the field that knows a lot about injection molding was present at the customer to help out' *Marketing manager* 'Together with (marketing manager *ed.*) I worked with (caps and closures manufacturer ed.) to validate our product and get it through development and commercialization' *Sales manager*

Senior management involvement

The senior managers of Gamma's marketing organization and the top management team of Gamma were, to some extent, involved in the market learning of project *Dye*. During initiation, they framed

the search for new market knowledge by emphasizing the strategic focus to look into the anti-counterfeiting segment for product differentiation purposes. They also appointed a marketing manager who was totally dedicated to building up knowledge in this field. During development and commercialization, senior managers supported project members by allocating resources to carry out market analyses. However, in these phases they also put effort in controlling market learning. The marketing manager had to present an extensive business case to senior management before the resource request for development was approved. Additionally, she had to report regularly on project progress and market feedback (Table 7.18).

Table 7.18: Senior management involvement Dye

(phase; period) Senior management involvement	**Case study evidence**
(Initiation '05-'06) Framing	'Before I was appointed, the dye was already developed. One of my colleagues in the U.S. started a project in 2004 in the field of CD and DVD. I was appointed because senior management wanted to extend the existing market focus and look for applications beyond CD and DVD' *Marketing manager*
(Developm. and commercialization '06-'08) Support / Control	'For larger projects and new things we have the Growth Initiative Board (GIB) which consists of several senior managers. Here we present our programs and ask for funding if needed. This project got approved by the GIB. Every month I have to write a summary on progress related to specific points such as total available market, industry fit and confidence levels, projections...Every three months I also do presentations where we have a dialogue with the GIB' *Marketing manager* '(Marketing manager) has to report every three months and has to show what she is doing, and what she needs to move ahead' *Sales manager* 'To start a (development phase *ed.*) you have to have an indication of what the market is, and an indication in terms of price...and at least a potential market or customer that could be interested. So you have to do some kind of assessment even though it is not 100% clear at that moment' *Sales manager*

Market knowledge generation

In the initiation phase of *Dye*, customer knowledge was updated and segment knowledge was developed by doing desk research, visiting conferences and talking with existing customers. Additionally, the marketing manager used an explicit step-by-step framework which is used throughout Gamma's marketing organization to map the anti-counterfeiting market segment. In the development and commercialization phases, market knowledge was mainly developed and updated by collaborating with the caps and closures manufacturer that was used as launching customer (table 7.19).

Table 7.19: Market knowledge generation Dye

(phase; period) Market knowledge generation	Case study evidence
(Initiation '05-'06) Desk research / Visiting conferences / Customer visits / Using framework	'In 2005 I started to work on it. The first year I really did a lot of background research. A lot of internet, statistics and looking at custom studies. I also went to conferences on brand protection and talked to customers in diverse traditional industries, trying to understand the segment, general problems and needs' *Marketing manager* 'Together with (marketing manager *ed.*) I went to several customers and we found out that (caps and closures manufacturer *ed.*) was interested' *Sales manager* 'We use a framework in marketing with different phases. When initiating a project you have a market assessment phase, and there are different tools available which you can use for, for example, market mapping and segmentation. Some of them are even required in developing the business case' *Marketing manager*
(Developm. and commercialization '06-'08) Collaborating with customer	'In this project we collaborated with (caps and closures manufacturer *ed.*) which was our validation partner. Together with them we tested product prototypes' *Marketing manager* 'During development the customer tested our prototype products and we received feedback on that' *Researcher*

Market knowledge integration

For project *Dye*, market knowledge integration in the initiation phase occurred by the marketing manager making use of her internal organizational network. The marketing manager contacted several sales managers from different European countries and asked them to help her to find out if there was specific customer interest for the anti-counterfeiting solution. Later on, during development and commercialization, recurrent team meetings were used, and prototypes were discussed. The team also used a development framework which is known throughout the organization. The use of this framework resulted in common language and awareness of different responsibilities across the team. This provided additional support for market knowledge integration. However, to some extent market knowledge integration was also disturbed because two departments (i.e. color technology department and the compounding product line) had difficulties in collaborating.

Table 7.20: Market knowledge integration Dye

(phase; period) Market knowledge integration	Case study evidence
(Initiation, '05-'06) Internal organizational network	'I tried to reach customers via our commercial organization...I have a 12 year history in this company so I know these guys (that are working in the commercial organization *ed.*). I know who is working in certain areas, so I call them.....Basically you need to know them and convince them' *Marketing manager* '(Marketing manager *ed.*) approached me to talk about this new dye' *Sales manager*
(Developm. and commercialization '06-'08) Recurrent meetings / Prototypes / Implementation framework	'When we were making samples I had regular meetings with several sales colleagues and people from technology. Because we are people that work in remote locations this means a lot of teleconferencing' *Marketing manager* 'We had regular calls with (marketing manager *ed.*) where we discussed samples. It worked well because we had a good relationship with her' *Researcher* We did teleconference meetings where everyone from each department calls in' *Sales manager* 'When we decided to change the resin, this meant that, internally, we had to move from one product line to the other. The product lines were ok with that but we had some discussion with color technology....there is a lot of history behind this...color technology has difficulties working with the product line to which the project was relocated because they sometimes act rather independently. So things did not move as quickly as they should' *Marketing manager* 'Maybe you have heard it from (marketing manager *ed.*) but we had some differences in opinion with color technology in the U.S. about UV stability...there is a lot of politics behind it' *Researcher* 'The product lines and their technology groups used a cross-functional framework to actually develop the product. It parallels our validation stage, and I was also involved' *Marketing manager* 'We used the product line's cross-functional development framework involving technology, sales and marketing' *Sales manager*

7.4 Overall comparison

This chapter discussed findings on projects that fall into the 'tech/market-discontinuities' project category. Based on the accumulated data from three cases, *Anti-resist* (Beta), *Foam* (Gamma), and *Dye* (Gamma) some similarities and differences between cases can be brought to light.

Similarities

In all three cases project members searched for new application need and new product usage knowledge, while leveraging and updating market knowledge on one or more of the other market knowledge dimensions.

What were the similarities in configuration of the marketing organizations that triggered and allowed project members to carry out this specific type of market learning? First of all, in all three cases, the business unit's senior management tried to influence market learning by adopting multiple roles. In the initiation phase, these managers framed specific strategic areas to update or search market knowledge. They either identified and articulated an already defined market segment as focus area or they emphasized searching for new segments and new application spaces. In the development and commercialization phases of the product innovation projects, senior managers supported market learning by providing resources to the project members and by acting as sounding

board when necessary. However, to some extent, senior management also controlled market learning efforts by tracking progress and asking for market feedback updates from project members. Additionally, in all three cases, the organizational members that carried out the marketing function were specialists and showed the skills to carry out desk research on market segments and to interview existing customers in the initiation phase of the projects. In the later phases these managers were able to develop collaborations with customers to test product prototypes. Finally, in all three cases the project members that performed the marketing function were able to collaborate and interact with other participating project members in the course of the product innovation projects. Cognitive barriers between functional specialists that can hamper knowledge integration were, eventually, successfully mitigated. Important practices used to develop a shared language and narratives between project members were recurrent meetings, using an implementation framework, and discussing new product prototypes.

Differences

The overall comparison revealed only small differences between projects *Foam* and *Dye*. While project *Foam* was in need of a high level of investment, project *Dye* could be carried out with a medium level of investment. Furthermore, project members in *Dye* used an additional market knowledge generation practice in the project's initiation phase: visiting conferences.

Larger differences could be observed when distinguishing between project *Anti-resist* on one side and projects *Foam* and *Dye* on the other side. The first difference relates to market learning behavior. While organizational members involved in project *Anti-resist* focused on generating and integrating new market knowledge on two dimensions (product usage, and application need), employees involved in projects *Foam* and *Dye* did this on three dimensions (segment, product usage, and application need). In project *Anti-resist*, project members kept acting within the borders of a familiar market segment. As the business manager involved in *Anti-resist* put it:

> '(Anti-resist *ed.*) is a new product and a new application for us. This is quite exciting because we do not disturb our current application in this market segment. Market segment is the same, but it is a new application in the tire market. We are not replacing anything. So we already had relationships and were familiar with the market. This is an added value of the project. Since the market is known it is easier to interact. We have an innovation group also, but they are looking at different markets and they have a lot of difficulties talking to potential customers because they are not experts in a particular market segment'

In contrast, although project members in project *Foam* and *Dye* used existing customers as launching customers, they had to get familiar with market segments that were totally new to the organization. They had to analyze these first before they could make deliberate investment decisions. A large part of these two projects consisted of just getting familiar with these newly identified market segments.

Furthermore, two differences in the organizational context of market learning could be observed between project *Anti-resist* on the one hand and projects *Foam* and *Dye* on the other hand. The first difference has to do with the task focus of the organizational members that carried out the

marketing function in the projects under study. While in all three projects these organizational members had other projects and tasks next to the project that was analyzed, the ones in *Foam* and *Dye* had more focused tasks. The organizational members that carried out the marketing function in these two projects were mainly focused on either exploration or exploitation but not both. In contrast, the employees that carried out the marketing function in *Anti-resist* were involved in both exploration and exploitation. Because organizational members that were responsible for exploration in *Foam* and *Dye* were solely focused on exploration and not involved in activities that were carried out by the mainstream organization it is fair to say that the marketing function in *Foam* and *Dye* was relatively differentiated from the mainstream organization. This was not the case in project *Anti-resist*. The second difference relates to market knowledge generation practices. While in project *Anti-resist*, organizational members that carried out the marketing function solely relied on desk research and contacting customers to generate market knowledge in the initiation phase of the project, the organizational members in *Foam* and *Dye* also used a formalized framework that was available in the global marketing organization of Gamma. A reason for this difference might be that in the case of project *Anti-resist*, the project members updated their segment and customer knowledge while project members in projects *Foam* and *Dye*, in contrast, had to develop new segment knowledge. In the latter two projects, the organizational members that carried out the marketing function had to collect and make sense out of more relatively new market information. A formalized framework which emphasizes specific tasks could help them navigating through these uncharted market spaces. For *Anti-resist*, which was based on familiar segment knowledge, codified within organizational documents and tacit within employee heads, there was, probably, less need for such a framework. Using such a framework in project *Anti-resist* would likely have over-formalized market knowledge generation.

8 Cross-case comparison

Chapter eight presents a cross-case comparison of the ten cases that were discussed separately in chapters five through seven. The purpose of this chapter is to compare the findings on the ten individual cases and discuss similarities and differences. The cross-case comparison is more parsimonious than the individual case descriptions. However, because it is based on insights that were found across cases, it is more robust. This comparison will be the main source of input for drawing general conclusions. In general, this chapter follows the structure of the conceptual framework that was presented in chapter three. However, two explanatory concepts that emerged during data analyses are added: project success and investment level. This chapter starts with discussing project success and the observed market learning behavior across projects. Additionally, we illustrate that based on the 'overall level of exploration in market learning strategy' three separate groups of projects can be constructed. Next, differences and similarities in dimensions of ambidextrous marketing organizations between these groups are discussed. In discussing these dimensions, we also highlight their changes in the course of a product innovation project. This chapter concludes with a summary.

8.1 Project success

At the start of the empirical study, ten projects were selected for in-depth investigation. These projects were introduced into the market less than three years ago (*Heat, Green, Gears, Diffuse, Additive, Anti-resist, Foam, Dye*) or were close to market introduction (*Anti-tracking, Bond*). Consequently, by using 'market introduction' as intermediate measure for success, at least, eight of the ten projects under study can be considered successful. During our research, also project *Bond* became part of the success group because the resulting product could be introduced into the market. In contrast, developments in project *Anti-tracking* could not be commercialized and therefore this project can be considered unsuccessful by the standards taken in this study. Strong evidence was found that an important reason for struggling with market introduction was the lack of generating and integrating segment knowledge. Project *Anti-tracking* illustrates the need for a significant level of market knowledge for effective and efficient product development and helps to make a distinction between sufficient and insufficient market learning. However, this project will not be included in further cross-case comparison. This decision is made because the present research studies how organizations resolve the market learning paradox in product innovation processes. It does not study the amount of market learning in relationship with project success or failure. Consequently, the remainder of this chapter discusses the cross-case comparison of the nine remaining cases: *Heat, Green, Additive, Diffuse, Bond, Gears, Anti-resist, Foam,* and *Dye.*

8.2 Market learning

Market learning in product innovation refers to the generation and integration of market knowledge in the course of a product innovation trajectory. In each of the nine projects, project members

combined exploration and exploitation in market learning across dimensions in a single product development project phase. For example, market knowledge on a newly defined market segment was generated and integrated in the initiation phase by, among other sources, making use of existing customer contacts. New application need knowledge was generated and integrated in the development phases by prototyping 'off the shelf' products in new applications. Additionally, it was observed that exploration and exploitation within a single market knowledge dimension were combined in different product development project phases. For example, collaborations with potential customers in a project's development phase resulted in new market knowledge (i.e. exploration), that was refined in the commercialization phase (i.e. exploitation). The upper limit for exploration in the projects under study was three market knowledge dimensions. In none of the projects we observed exploration on all four market knowledge dimensions.

Based on the 'overall level of exploration in market learning strategy' that could be attributed to a single project it is possible to develop three groups of projects (table 8.1). The first group includes projects *Heat* and *Green* which displayed a low level of exploration. In both projects attention was centered on a segment, applications and customers that were already familiar to the firm (i.e. exploitation). Exploration in market learning was limited to the product usage dimension during the development phase of the projects. In this phase experimentation took place by means of testing prototype products that were based on new technological knowledge and therefore new in the market.

Table 8.1: Groups of projects based on the 'overall level of exploration in market learning strategy'

Project	Original category	Level of exploration (new category)	Exploration segment	Exploration application need	Exploration product usage	Exploration customer
Heat	Tech-discontinuities	**Low**	No, only exploitation	No, only exploitation	**Yes**	No, only exploitation
Green	Tech-discontinuities		No, only exploitation	No, only exploitation	**Yes**	No, only exploitation
Diffuse	Market-discontinuities	**Medium**	No, only exploitation	**Yes**	No, only exploitation	**Yes**
Anti-resist	Tech/market-discontinuities		No, only exploitation	**Yes**	**Yes**	No, only exploitation
Additive	Market-discontinuities	**High**	**Yes**	**Yes**	No, only exploitation	**Yes**
Bond	Market-discontinuities		**Yes**	**Yes**	No, only exploitation	**Yes**
Gears	Market-discontinuities		**Yes**	**Yes**	No, only exploitation	**Yes**
Foam	Tech/market-discontinuities		**Yes**	**Yes**	**Yes**	No, only exploitation
Dye	Tech/market discontinuities		**Yes**	**Yes**	**Yes**	No, only exploitation

The second group contains projects *Diffuse* and *Ant-resist*. These projects both showed a medium level of exploration. Instead of one market knowledge dimension (i.e. product usage), as in the low-

exploration projects, exploration could be observed regarding two market learning dimensions. In *Diffuse* an existing product was used and project members worked within an already defined market segment (i.e. light management). Exploration in market learning took place in the development phase on the dimensions application need and customer. Project *Anti-resist* showed a similar level of exploration. However, on a market knowledge dimension level, it was not identical to project *Diffuse*. Instead of generating and integrating new market knowledge on the application need and customer dimensions, exploration took place with respect to the product usage and application need dimensions. Still, also in project *Anti-resist* the bulk of the exploration efforts took place during the development phase of the project. Finally, a group of projects with a high level of exploration can be identified. This group consists of projects *Additive*, *Gears, Bond*, *Foam*, and *Dye* which exhibited exploration in market learning on three market knowledge dimensions. While all projects in this group showed exploration on the segment dimension there were some differences when focusing on the other market knowledge dimensions. Project members in projects *Additive*, *Gears*, and *Bond* did target new customers and new applications, while employees involved in *Foam* and *Dye* generated and integrated new market knowledge on the product usage and application need dimensions. Timing wise, all projects in this group did combine exploration on the segment dimension with exploitation on another market knowledge dimension in the initiation phase of the project. In the development phase exploration on two other dimensions was combined with exploitation on a third market knowledge dimension.

Project grouping around the 'overall level of exploration in market learning strategy' fundamentally departs from the original classification alongside a technology and market axis which was introduced in the methodology chapter. Consequently, some groups in the new classification contain projects that originally did belong to separate groups. For example, the medium-exploration group includes both market discontinuities and tech/market discontinuities (see also table 8.1). However, as will be shown in the next paragraphs, the new classification discriminates better between the distinct natures of the separate dimensions of the ambidextrous marketing organizations.

8.3 Investment level

'Investment level' was not included as a notion in the conceptual framework, but emerged as discriminating concept during analyses. A distinction could be made between projects that needed a *low* level of investment, a *medium* level of investment and a *high* level of investment. Project *Diffuse* clearly needed a low level of investment for the business unit in which it was carried out. Most of the work by the development group could be done next to other projects and tasks, and no investments in new products, technologies, or manufacturing facilities were needed. In contrast, projects *Green* and *Foam* undoubtedly needed a high level of investment. This observation is largely based on both cases needing large investments in manufacturing facilities to introduce the new products into the market. The remaining six projects (i.e. *Heat*, *Anti-resist*, *Additive*, *Bond*, *Gears*, and *Dye*) needed a medium level of investment. Some projects required investments in research to develop new technology while the new product could be produced in existing facilities (e.g. project *Heat*), or

manufacturing was initially outsourced (e.g. projects *Anti-resist* and *Dye*). Other projects used 'off the shelf' technology or products and had to invest in generating and integrating market knowledge that was new to the business unit in which the projects were carried out (projects *Additive*, *Bond*, and *Gears*).

8.4 Marketing function

The central role in market learning in product innovation projects is carried out by the 'marketing function': organizational members that form the interfaces, or span the boundaries, between the project and the market. On the concept 'marketing function' the analyses focused on two elements: *specialization* and *task focus* (table 8.2).

Table 8.2: Marketing function

Overall level of exploration in market learning strategy	Initiation and implementation
Low *Heat, Green*	• Specialist(s) • Low task focus
Medium *Diffuse, Anti-resist*	• Specialist(s) • Low task focus
High *Additive, Bond, Gears, Foam, Dye*	• Specialist(s) • High task focus

Although the analyses on the individual cases showed that the employees that carried out the marketing function had different job titles, such as 'new business development manager' or 'sales manager', they were all specialists: their official job description included establishing an interface with the market. In none of the projects that were analyzed, non-specialists, such as researchers or manufacturing engineers, unofficially added the marketing function to their task. Usually there were one or two specialists involved throughout a project, or there was a general manager from a higher hierarchical level who gave support to a functional specialist. For example, in project *Dye* the marketing function was carried out by a marketing manager and a sales manager, and in project *Green* the business manager assisted sales managers in the initiation phase of the project in this task.

On task focus of the marketing function, a distinction could be made between a low and a high task focus. In projects with a low and medium level of exploration, employees that carried out the marketing function had a low task focus. A low task focus implies that the specialists had a central role in both the exploration and exploitation part of the market learning that took place via the project. Additionally, these specialists were highly integrated in the mainstream organization, which implies that next to the project under study, they were also involved in other projects and/or tasks that maintained the stability or efficiency of the running business such as selling or answering questions from customers. In contrast, in high-exploration projects the employees that carried out the marketing function had a high task focus. A high task focus implies that either these employees had a central role in exploration and exploitation but were totally dedicated to the project under

study and freed from other responsibilities (projects *Additive, Bond,* and *Gears*) or these employees were involved in several projects but only focused on the exploration or the exploitation part of market learning in the project under study (projects *Foam, Dye*). In terms of integration and differentiation, a high task focus implies that the marketing function as a whole was relatively less integrated in the mainstream organization.

8.5 Senior management involvement

Senior management refers to organizational managers that allocate and control product innovation resources but are not, like project members, involved in day-to-day project activities. In most cases these managers belong to the top management team of the organization or are their direct reports such as general product managers. The analyses on individual cases revealed that senior management involvement in the market learning during product innovation could be captured by four distinct management roles: *directing*, *framing*, *supporting*, and *controlling.* Additionally, we observed a significant change in roles when projects moved out of the initiation phase, where market learning is used for idea generation, and entered the implementation phase, where market learning is used in project execution. Because limited change in roles was observed when the project moved from the development phase to the commercialization phase, we combined these two phases and called this combination *implementation* (table 8.3).

Table 8.3: Senior management involvement

Overall level of exploration in market learning strategy	Initiation	Implementation
Low *Heat, Green*	• Directing	• Supporting /Controlling
Medium *Diffuse, Anti-resist*	• Framing	• Supporting/Controlling (Diffuse: Limited controlling)
High *Additive, Bond, Gears, Foam, Dye*	• Framing	• Supporting/Controlling

Both directing and framing directly result from the organization's innovation strategy and relate to initiating the generation and integrating of market knowledge at the start of a project. Directing refers to senior managers giving concrete assignments to organizational members acting on a lower hierarchical level to update market knowledge on specific dimensions. Senior management used directing in the specific case of low-exploration projects. In project *Heat*, for example, senior managers became aware of the market trend that due to new engine designs operating temperatures would become higher. Because they wanted to maintain market leadership in the engine segment they asked application development to investigate specific future application needs on engine parts at existing customers. Framing differs from directing in the sense that senior management is not giving concrete assignments but articulates a, less specific, strategic direction that can trigger the generation and integration of market knowledge on a lower hierarchical level.

Framing is the articulation of the business unit's vision of what it wants to achieve beyond the near future. Framing was observed in projects with a medium and high overall level of exploration in market learning strategy. For example, in the case of project *additive*, senior management articulated the intent to 'get more out of the existing product line by looking for new market segments' which resulted in organizational members generating market knowledge and developing new ideas.

After project approval by senior management, implementation (i.e. development and commercialization) takes place. At the start of the implementation trajectory, senior management's involvement switched from directing or framing to project supporting and controlling. Supporting refers to the allocation of human and financial resources to carry out necessary market analyses and acting as sounding board for project members. Controlling refers to tracking progress in market analyses, detecting deviations from original plans, and taking action when it is deemed necessary. Carrying out support and control did not happen in distinct periods of time but occurred simultaneously. On supporting and controlling no clear differences were found between the three groups of projects. The one exception found was project *Diffuse*. During implementation limited senior management controlling was observed. It might be that because this project needed limited investments, there was less risk involved and therefore it gained less senior management attention.

8.6 Market knowledge generation

On practices to generate knowledge from the market, it was found that in all projects employees scanned the market in the initiation phase by doing *desk research*. This desk research was combined with *visiting conferences or trade-fairs* and/or *visiting existing customers*. In low-exploration projects, market knowledge generation practices were used to update segment, application need, and customer knowledge. For medium-exploration projects these practices were used to update market knowledge on two dimensions: segment and customer (project *Anti-resist*) or segment and product usage (project *Diffuse*). Finally, for high-exploration projects these practices were used to generate new segment knowledge and update market knowledge on one additional market knowledge dimension. Furthermore, an additional market knowledge generation practice was used in the initiation phase of two high-exploration projects (i.e. *Foam* and *Dye*): *using a market knowledge generation framework*. Project members used a formalized 'market assessment' process that supported them in this phase with market mapping and segmentation tools to collect and interpret new market information. This framework which emphasized specific tasks that had to be carried out could help them to navigate through uncharted market space and to make sense out of lots of unfamiliar market data (table 8.4).

Table 8.4: Market knowledge generation

Overall level of exploration in market learning strategy	Initiation	Implementation
Low *Heat, Green*	• Market scanning by desk research in combination with visiting conferences and existing customers	• Collaborating with customers to test prototypes
Medium *Diffuse, Anti-resist*	• Market scanning by desk research in combination with visiting trade-fairs and/or existing customers	• Collaborating with (potential) customer(s) to test prototypes
High *Additive, Bond, Gears, Foam, Dye*	• Market scanning by desk research in combination with visiting conferences and/or existing customers • Using framework (Foam, Dye)	• Collaborating with (potential) customer(s) to test prototypes • Hiring segment specialist(s) (Additive, Bond, Gears)

During development and commercialization, project members in all projects under study *collaborated* with one (potential) customer or a small group of (potential) customers *to test prototypes*. In these phases, testing prototypes was used to generate new market knowledge, or update existing market knowledge on the product usage, application need, and customer dimensions. Because we did not observe significant differences in market knowledge generation practices used in the development phase compared to the commercialization phase we combined these and labeled this set of activities *implementation*. Again, an additional market knowledge generation practice was found in three high-exploration projects (projects *Additive*, *Bond* and *Gears*): *Hiring segment specialist(s)*. In these cases the organization hired new employees that had extensive knowledge on the market segment that the firm was entering by carrying out the product innovation projects under study. For example, in project *Additive* the organization hired two people that had 20+ years of experience in the plastics segment which was a newly defined market segment for the firm and the focus in the project. Hiring segment specialists supported market knowledge generation in these projects because these new employees increased the firm's absorptive capacity in the direction of the newly defined market segment.

8.7 Market knowledge integration

Market knowledge integration refers to bringing together different dimensions of market knowledge but also linking overall market knowledge with other knowledge relevant in product innovation such as technological and manufacturing knowledge.

Two different practices were found that were used to integrate market knowledge during the initiation phase of the product innovation projects under study: *using the hierarchy of authority* and *using the internal organizational network*. In low-exploration projects it was found that market knowledge was integrated by using the hierarchy of authority. This implies that senior managers collected market knowledge, including the knowledge that was generated by employees that were

acting on a lower hierarchical level, and other relevant knowledge, and integrated it[28]. For example, in project *Heat* the European product manager collected the necessary information, compiled it, and wrote the business plan that formed the foundation to implement the project. In contrast, market knowledge integration in the initiation phase of the projects with a medium to high level of exploration in market learning strategy occurred with limited senior management involvement. In these cases, employees acting on a lower hierarchical level *used their internal organizational network* to integrate market knowledge. Different functional specialists contacted each other to discuss ideas in which they used newly generated or updated market knowledge. For example in project *Foam*, the sales manager contacted employees that worked in the product line and the marketing department to discuss new market developments and how to react. An exception was project *Bond* where the organizational network was not used. In this project there was only one organizational employee involved and market knowledge integration occurred 'within' this single person (table 8.5).

Table 8.5: Market knowledge integration

Overall level of exploration in market learning strategy	**Initiation**	**Implementation**
Low *Heat, Green*	• Using the hierarchy of authority	• Having recurrent team meetings • Discussing prototypes • Using cross-functional implementation framework (Heat)
Medium *Diffuse, Anti-resist*	• Using the internal organizational network	• Having recurrent team meetings • Discussing prototypes • Using cross-functional implementation framework (Anti-resist)
High *Additive, Bond, Gears, Foam, Dye*	• Using the internal organizational network (Bond: Only one function involved)	• Having recurrent team meetings • Discussing prototypes • Using cross-functional implementation framework

During development and commercialization, project members in the projects under study relied on *having recurrent team meetings*, *discussing prototypes*, and using *cross-functional implementation frameworks* to integrate market knowledge. Because we did not observe significant differences in market knowledge integration practices used in the development phase compared to the commercialization phase, we combined these and labeled this set of activities *implementation.* Recurrent meetings were used for interaction between different functional specialists. In these meetings progress and insights were discussed and work was synchronized. However, in two projects (project *Foam* and *Dye*) market knowledge integration was somewhat hampered by lack of collaboration between several functional specialists. Additionally, market knowledge integration was supported by project members discussing prototypes and using a cross-functional implementation framework. These 'boundary objects' resulted in common language and awareness of different

[28] It can be argued that for low-exploration projects next to 'directing', 'integrating' is an additional senior management role that could be observed in the initiation phase.

responsibilities in product innovation across the functional specialists working on the project, decreasing the changes that cognitive boundaries would have a negative impact on market knowledge integration.

8.8 Summary

This chapter presented a cross-case comparison of the ten cases that were discussed separately in chapters five through seven. The purpose of this chapter was to compare the findings on the ten individual cases and discuss similarities and differences. This cross-case comparison will be the main source of input for drawing general conclusions in chapter nine. Based on project success level it was decided to drop project *Anti-tracking* from the comparison because the outcome of this project could not be introduced into the market in the timeframe of this research. It appeared that regrouping the projects based on 'the overall level of exploration in market learning strategy' instead of using the initial classification, which used a technology and a market axis, resulted in an improved discrimination between the distinct nature of the separate dimensions of the ambidextrous marketing organizations. Furthermore, we dropped the distinction between the last two product innovation phases because we did not observe significant changes in organizational dimensions when moving from development to commercialization. Taking the 'overall level of exploration in market learning strategy' as starting point, focusing on the concepts investment level, marketing function, senior management involvement, market knowledge generation practices and market knowledge integration practices, and tracking the projects over time, we found several clear qualitative differences in organizational dimensions when resolving the market learning paradox in product innovation. Comparisons at the level of the individual organizational dimensions sometimes resulted in overlapping results. For instance, in all three categories senior management used a combination of supporting and controlling in the implementation phase. However, as will be shown in the next chapter, combining these elements, and using the 'level of exploration in market learning strategy' and 'the product innovation project phase' as contingency factors results in three unique ambidextrous marketing organization configurations by which firms resolve the market learning paradox in the course of really new product development projects.

9 Conclusions and discussion

This final chapter presents the main conclusions of this research and discusses its implications for theory and practice. After presenting a general answer to the research question in the first section, a more detailed discussion is presented in sections two and three. This discussion is organized around the general structure that was already used in chapter three and the chapters that discussed the empirical study. After presenting managerial implications, this chapter concludes with the limitations of the current research that provide meaningful opportunities for further research.

9.1 Answering the research question

This research provides insight into the way organizations, and specifically business units in the chemical industry, can introduce really new product innovations and still be oriented towards the market. It presents how organizations can resolve the market learning paradox (i.e. combining exploitation and exploration) when developing really new products. By taking an integral perspective on market learning in product innovation we aimed to answer the following research question:

> *'How do firms resolve the market learning paradox in the course of really new product development projects?'*

Based on an in-depth analysis of market learning behavior and several important dimensions of the configuration of the marketing organization in nine successful product innovation projects in different organizational settings we are able to answer this question. In one sentence our answer is:

> *'It heavily depends on the ratio between exploration and exploitation in the market learning strategy and the specific product development process phase of a product development project'*

This conclusion, together with a theoretical discussion, is further elucidated in the following sections. In these sections we have numbered key findings and make them stand out by using an italic font style.

9.2 Market learning

In this research, market learning in product innovation refers to the generation and integration of market knowledge in the course of a product development trajectory. This research reveals that the content of market learning (i.e. market knowledge) should be treated as a multi-dimensional construct.

> *1a) While the majority of research in marketing and product innovation, at most, distinguishes between two dimensions in market knowledge in product innovation (i.e. market segment knowledge and customer need knowledge), data from this research suggest four dimensions*

(figure 9.1): segment knowledge, product usage knowledge, application need knowledge, and customer knowledge (Smits et al. 2009).

Segment knowledge refers to knowledge on market size, growth rate and turbulence, and stakeholders such as competitors, distributers, and regulating groups which can influence customer behavior. This market knowledge dimension has some precedent in the marketing and innovation literature. It reflects what Jaworski and Kohli (1996: 126) have called 'a sensitivity....to the underlying forces that shape a market or industry' and relates to the dynamics in exogenous factors that shape customer needs and wants. Furthermore, Veldhuizen et al. (2006), for instance, use 'environmental information' to identify competitor and general industry information, while research by Adams and colleagues (1998) used the term 'business data' to identify knowledge on issues such as emerging trends in the marketplace, competitors, and estimates of market size.

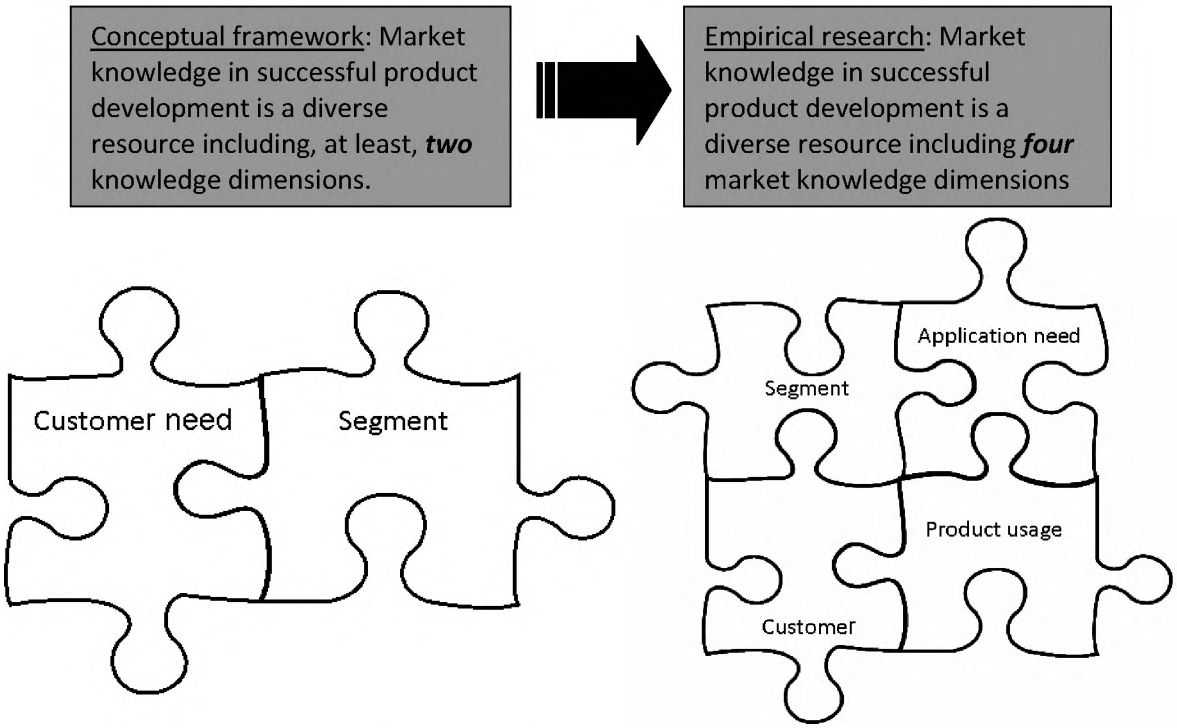


Figure 9.1: Market knowledge in successful product development

In addition, our research suggests that the general dimension of customer need knowledge, as it is used in the majority of the literature (Kohli and Jaworski 1990; Narver and Slater 1990), can further be detailed by the independent dimensions product usage knowledge and application need knowledge. Product usage knowledge is about knowledge on the use of a product by customers[29] and its behavior in downstream manufacturing processes, and application need knowledge is about knowledge on customer needs and wants a product should satisfy in specific applications and refers to application requirements. Finally, our research identifies customer knowledge. This is a knowledge

[29] In this research the term 'customer' refers to business-to-business customers such as downstream manufacturers.

dimension which is seldom discussed in empirical studies in marketing and product innovation[30]. This knowledge does not refer to customer needs and wants but relates to other relevant knowledge related to customers such as contact information, knowledge on the 'decision making unit' and knowledge on the customer's innovation strategy.

Furthermore, this research distinguishes between exploitation and exploration in market learning. Exploitation refers to updating and integrating market knowledge that already resides in the firm while exploration is about generating and integrating market knowledge that is new to the organization. Both types of learning fulfill complementary roles in product innovation (March 1991; Moorman and Slotegraaf 1999). Exploitation increases the impact of exploration by refining new knowledge and reaping its benefits, and acting as 'stepping stone' for exploration. Similarly, exploration overcomes the inherent limitations of exploitation, such as lack of breakthrough learning and the inability of adapting to significant environmental changes. Our process data shows that in each of the nine projects, exploitation and exploration in market learning were combined across distinct market knowledge dimensions in the same period of time and over time within a single market knowledge dimension. Following Penrose's (1959: 70) metaphor, who saw firm resources as pieces of a 'jigsaw puzzle' which are combined and recombined to produce outputs, organizations delink pieces of market knowledge from existing products and operations and try to link these to new pieces of market knowledge and other relevant pieces such as technological and manufacturing knowledge. Eventually, if they find combinations that seem to fit, they refine these combinations to the extent that the output (i.e. the product) can be introduced into the market.

1b) Based on the 'overall level of exploration in market learning strategy', three different types of product innovation projects could be identified. Projects with a low level of exploration in market learning demonstrated exploration on one market knowledge dimension. Projects with a medium level of exploration demonstrated exploration on two market knowledge dimensions. Finally, projects with a high level of exploration demonstrated exploration on three market knowledge dimensions.

1c) Although we aimed at selecting a wide variety of product innovation projects, from this study it appears that the most fruitful approach to product innovation lies at the intersection of exploitation and some level of exploration. At maximum, exploration took place on three of the four market knowledge dimensions. Hence, in none of the projects under study it was found that new knowledge was generated and integrated on all four market knowledge dimensions.

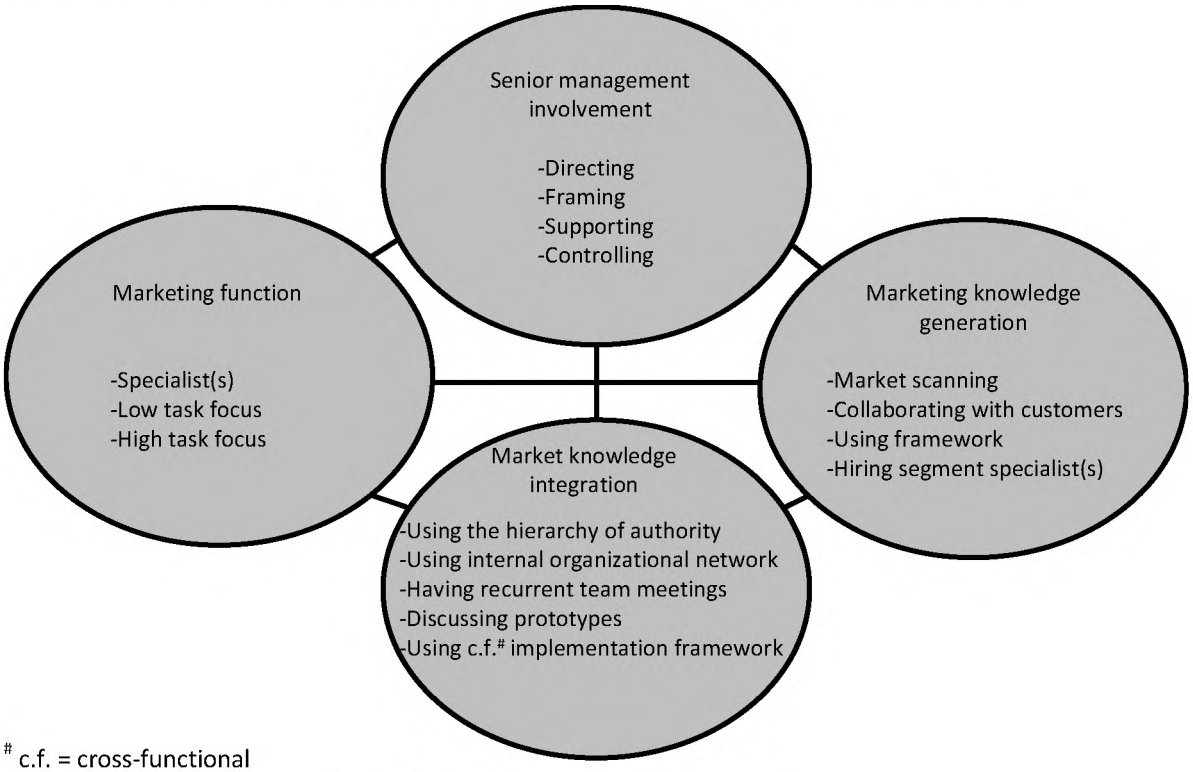
Finding 1c is in line with some arguments that can be found in prior work. Based on the 'path dependency' argument, Nelson and Winter (1982), for instance, have argued that even the most innovative form of exploration is built on a small set of existing skills. Cohen and Levinthal (1990) demonstrate this with their discovery that firms need some existing knowledge that is used as

[30] Notable exceptions are Abernathy and Clark (1985), Moorman and Slotegraaf (1999), Danneels (2002), and Zahay et al. (2004).

'absorptive capacity' to integrate new knowledge. Other researchers, such Danneels (2002), O'Reilly and Tushman (2008) and Brown and Eisenhardt (1997), argue that it simply makes more sense, from a risk-taking point of view, for established firms to leverage existing resources and capabilities in their journeys of product renewal than to start from scratch.

9.3 Organizational configurations

The cases in this study highlight the dynamics in organizational configurations for resolving the market learning paradox in the course of really new product innovation as well as their diversity. In our conceptual framework we included four dimensions of ambidextrous marketing organizations: marketing function, senior management involvement, market knowledge generation and market knowledge integration. Based on our empirical research we are now able to further detail these dimensions and present an overall collection of possible characteristics (figure 9.2).



c.f. = cross-functional

Figure 9.2: Detailed dimensions of ambidextrous marketing organizations

Furthermore, we found that firms do not use one typical configuration of their marketing organization to become ambidextrous and resolve the market learning paradox in product development:

2a) Configurations of the marketing organizations were adapted to changing contingencies in the course of a product innovation project. In this respect, the most significant change was observed when projects moved out of the initiation phase, where market learning was used for idea generation, and entered the implementation phase, where market learning was used in project execution.

2b) By distinguishing between projects with a low, medium, and high level exploration we found that the 'overall level of exploration in market learning strategy' had an impact on suitable organizational configurations.

While there is some support in the literature for the distinction between initiation and implementation for organizing product development activities (Duncan 1976; Zaltman et al. 1973), prior studies that specifically take the level of exploration into account are scarce[31].

A cross-classification of two product innovation project phases (i.e. initiation and implementation) and three levels of exploration (i.e. low, medium, high) yields three different supporting configurations of a firm's marketing organization and necessary changes in the course of a product innovation process (tables 9.1 and 9.2). Although rather distinct configurational archetypes can be identified, there is some overlap. When focusing on changes over time, for instance, we found that the characteristics of the marketing function did not change when projects moved out of the initiation phase and entered the implementation phase. Additionally, when focusing on the level of exploration in market learning, we found that, specifically in the initiation phase, the characteristics of the dimensions of the ambidextrous marketing organizations did gradually change when moving from projects with a low level of exploration to projects with a high level of exploration. Consequently, taking into account this latter finding, the largest differences in a suitable ambidextrous marketing organization were found when contrasting the initiation phase of low-exploration projects with the initiation phase of high-exploration projects.

We also found that some market knowledge generation and integration practices did not emerge in all projects facing the same contingencies. This represents configurational equifinality in which managers have latitude in design options to address conflicting contingencies (Eisenhardt and Martin 2000; Gresov and Drazin 1997). It appears that depending on the heritage and preferences of the organization equally valid, but slightly different, ambidextrous marketing organizations can be created. For example, with regard to market knowledge generation practices in the case of initiating high-exploration projects (table 9.1, configuration I), a formal framework was used in project *Foam* but not in project *Additive*. This section continues with discussing the theoretical implications of our findings on organizational configurations in more detail.

Marketing function

The marketing function connects 'the market' with other groups in the organization that are relevant in product innovation such as research and manufacturing. By connecting the customer to product design it plays a central role in market learning (Day 1994a; Workman 1998). Based on our research, two features of the organizational configuration by which organizations resolve the market learning paradox can be attributed to the concept of marketing function: functional specialization and task focus.

[31] A notable exception is McGrath (2001).

Table 9.1: Three organizational configurations to support market learning (initiation phase)

Project initiation phase (starting up the project)			
Level of exploration ⇒	**Low (I)**	**Medium (II)**	**High (III)**
Configurational dimension ⇓			
Marketing function			
• Specialist(s)	√	√	√
• Low task focus	√	√	
• High task focus			√
Senior management involvement			
• Directing	√		
• Framing		√	√
• Supporting			
• Controlling			
Market knowledge generation			
• Market scanning	√	√	√
• Collaborating with customers to test prototypes			
• Using framework			(√)[#]
• Hiring segment specialist(s)			
Market knowledge integration			
• Using the hierarchy of authority	√		
• Using the internal organizational network		√	(√)
• Having recurrent team meetings			
• Discussing prototypes			
• Using cross-functional implementation framework			

[#] Practices within parentheses were not found in all cases facing the same contingencies.

Table 9.2: Thee organizational configurations to support market learning (implementation phase)

Project implementation phase (developing the product and introducing it into the market)			
Level of exploration ⇒	**Low (Ia)**	**Medium (IIa)**	**High (IIIa)**
Configurational dimension ⇓			
Marketing function			
• Specialist(s)	√	√	√
• Low task focus	√	√	
• High task focus			√
Senior management involvement			
• Directing			
• Framing			
• Supporting	√	√	√
• Controlling	√	√	√
Market knowledge generation			
• Market scanning			
• Collaborating with customers to test prototypes	√	√	√
• Using framework			
• Hiring segment specialist(s)			(√)[#]
Market knowledge integration			
• Using the hierarchy of authority			
• Using the internal organizational network			
• Having recurrent team meetings	√	√	√
• Discussing prototypes	√	√	√
• Using cross-functional implementation framework	(√)	(√)	√

[#] Practices within parentheses were not found in all cases facing the same contingencies.

In line with the majority of the findings from previous research in marketing (Becker and Lillemark 2006; Rust and Moorman 1999; Verhoef and Leeflang 2009; Veryzer 2005) this research underwrites the importance of a specialized marketing function for market oriented really new product innovation.

3a) Although we did find differences in structure, responsibilities, and terminology between projects under study, in all organizational configurations we observed that the project's marketing function was carried out by specialists, such as application developers, product managers, sales managers, and new business developers, or combinations of those. In none of the projects this function was carried out as extra task by project members that had research or manufacturing as their major responsibility.

Although the marketing literature is not very explicit on possible organizational structures associated with the paradoxical task of combining exploration and exploitation in market learning, the literature on organizational learning and specifically the organizational ambidexterity branch offers some general guidance in this matter. This latter stream of literature argues that ways to capture both exploration and exploitation have to include creative combinations of integration and differentiation in organizational structure (Raisch 2008; Raisch et al. 2009). One group of studies has advocated structural differentiation between the mainstream organization being active in exploitation and separate organizational groups or individuals that carry out exploration (Benner and Tushman 2003; Christensen 1997; Tushman and O'Reilly 1996). In these cases, integration of exploration and exploitation takes place by ambidextrous senior managers and lower level integration mechanisms such a meetings between project members from the two distinct parts of the organization (Gilbert 2006; Tran 2008). A second group of studies advocates integration in which exploration and exploitation are both carried out in the mainstream organization (Adler et al. 1999; Gibson and Birkinshaw 2004; McDonough and Leifer 1983). In these cases, the integrated organizational context should be complemented by 'tactical' structural differentiation practices, such as setting up project teams, quality circles, and job enrichment schemes, which enable organizational members to make choices and move back and forth between a more bureaucratic structure for routine tasks and a more organic structure for less routine tasks. Because neither differentiation with tactical integration nor integration with tactical differentiation will allow for maximizing both exploration and exploitation, an organizational designer's task is to determine the right degree of differentiation and integration in organizational structure. Recent voices have speculated that the right combination might depend on the relative importance of exploration and exploitation in organizational tasks (Raisch et al. 2009). This research inductively resulted in empirical findings that confirm this speculation. In short, we were able to distinguish between a low and a high task focus of a project's marketing function. A low task focus implies that the marketing function is strongly integrated in the mainstream organization and responsible for exploration and exploitation in the project under study as well as for more routine task such as selling existing products, answering customer questions or solving routine customer problems. In contrast, a high task focus implies that

the marketing function is less integrated in the mainstream organization. In these cases two different options were identified. In some projects where the marketing function had a high task focus it consisted of one or several well integrated organizational members that were responsible for routine tasks and for the exploitation part in the project and one or several other organizational employees that were less integrated and were responsible for the exploration part. In other projects, the marketing function consisted of one or more organizational members that were responsible for both exploration and exploitation in the project but were relieved from routine tasks and therefore showed limited integration in the mainstream organization.

3b) This research found indications that a marketing function that is carried out by organizational members with a low task focus seems to work well in projects with a low to medium level of exploration (tables 9.1 and 9.2, configurations I, Ia, II, and IIa). In contrast, it showed that for projects with a high level of exploration the marketing function might be better off with organizational members that have a high task focus (tables 9.1 and 9.2, configurations III and IIIa).

In high-exploration projects it is less likely that solely deploying organizational members that are highly integrated in the mainstream organization will yield successful results. When organizational designers ignore this advise, treat high-exploration projects as 'business as usual', and rely on highly integrated marketing functions, it is expected that organizational members that carry out the marketing function have to work in too many different 'thought worlds' (Dougherty 1992), which is often beyond their cognitive limits (March 1991).

Most literature on organizational ambidexterity has taken a static viewpoint on integration and differentiation and recommends fixed positions (e.g. Tushman and O'Reilly 1996). However, modern contingency theory has brought to light that alignment is a dynamic process rather than something that ends in a steady state. Organizations frequently need to reconfigure in order to adapt to changing internal and external contingencies (Short et al. 2008; Siggelkow 2002). Although some literature on organizational ambidexterity has taken a dynamic perspective, it remains unclear how differentiated systems that are designed for exploration evolve over time. Several studies point to the benefits of temporary decentralization in which mainstream organizations use differentiated units for exploration and then reintegrate them in later phases of the innovation life cycle when exploitation becomes more dominant (Siggelkow and Levinthal 2003; Westerman et al. 2006). In contrast, a second group of studies has shown that differentiated units can remain differentiated from the mainstream organization for long periods of time despite increasing levels of exploitation. For example, Raisch (2008) shows that the premium coffee maker Nespresso started out as a rather autonomous unit within the Nestlé Group and maintained this position for over two decades even though the level of exploitation increased.

3c) Our findings fit with this second group of studies and illustrated that for product innovation projects where the marketing function as a whole had a high task focus, and therefore was

relatively differentiated from the mainstream organization (tables 9.1 and 9.2, configurations III and IIIa) it maintained the same level of differentiation in the course of the project despite an increase of exploitation in market learning.

We speculate that the abovementioned finding results from the fact that the project periods which presented full exploitation (i.e. the commercialization phases) were too short and too tightly coupled with the other product development phases to justify changes in the structure of the marketing function.

Senior management involvement

The concept senior management involvement relates to organizational leadership. Senior management refers to organizational managers who are involved in strategic product planning and the allocation and control of product innovation resources but are not, like project members, involved in day-to-day project activities. Often these managers belong to the top management team of the organization or are their direct reports such as product managers. From previous literature we know that senior management (non)involvement can have an impact on market learning for really new product innovation. The product development literature has shown that a right balance of support and control has a positive impact on implementing really new product innovations (Bonner et al. 2002; Lewis et al. 2002; Swink 2000). Additionally, the marketing literature has underlined that senior management's strategic mission flexibility and the willingness to take risks, complemented by a certain tolerance for failure, supports market oriented really new product innovation (Atuahene-Gima et al. 2005; Jaworski and Kohli 1993; Kirca et al. 2005). Finally, the literature on organizational ambidexterity regards senior managers as playing an important role in resolving organizational learning paradoxes and fostering ambidexterity. In situations where units for exploration and exploitation are highly differentiated, it is argued that senior management should develop a compelling strategic intent that justifies the importance of both exploration and exploitation. Furthermore, it is proposed that these managers should have a large stake in integrating exploration and exploitation across the two separate units (O'Reilly and Tushman 2008; Smith and Tushman 2005; Tushman and O'Reilly 1996). Also when employees who are responsible for exploration are more integrated in the mainstream organization, senior management is important. As key leaders in organizations it is proposed that they should put in place strategies and systems that shape the exploration and exploitation behavior of organizational members acting on a lower hierarchical level (Ghoshal and Bartlett 1994; Smith 2006) or play a more catalytic role, in which they promote ambidextrous ideas that emerge bottom up (Floyd and Lane 2000; Gibson and Birkinshaw 2004).

In the context of resolving the market learning paradox in the course of really new product development projects, our analyses crystallized into four distinct senior management roles: directing, framing, supporting, and controlling. Directing and framing are product innovation strategy making roles whereas supporting and controlling are roles that were observed during project implementation. These four roles are largely in line with findings from earlier research. For instance, framing is quite similar to articulating a compelling strategic intent while supporting market learning

in really new product innovation, which is a rather uncertain activity by nature, is comparable to the willingness of senior management to take some risks. We add to the literature the importance of two internal contingency factors.

4a) We illustrated that although senior management was involved in every phase of the product innovation process, it changed its role from directing or framing in the initiation phase (table 9.1, configurations I, II, and III) to a combination of supporting and controlling in the implementation phase (table 9.2, configurations Ia, IIa, and IIIa).

4b) We observed an impact of the level of exploration on suitable senior management roles for project initiation. In situations with a low level of exploration we found a directing senior management role (table 9.1, configuration I), while for projects with a medium and high level of exploration we found that senior management adopted a framing role (table 9.1, configurations II and III).

This second finding challenges the theorizing of scholars that have focused on managing the initiation phase, or the front end, of product innovation (Kijkuit and Van den Ende 2007; Reid and de Brentani 2004). For example, Reid and De Brentani (2004: 176) suggested that incremental and really new innovations 'differ extensively in the way in which problems are structured and in which information searches are initiated at the fuzzy front end of new product development'. It was argued that for incremental innovations early stage opportunities and problems are identified and structured by the organization and information search is directed from senior management down to organizational members acting on a lower hierarchical level. In contrast, for really new innovations it was proposed that information is typically unstructured and brought in by functional specialists acting on a relatively low hierarchical level without such activity being explicitly directed by senior management. New business organizations may be asked generically 'to find something new' or 'challenge the strategic status quo' (i.e. framing) but concrete problems and opportunities are 'emergent' and 'flow from the bottom up' (Bartlett and Ghosal 1993; Burgelman 1991; 2002). By taking a more detailed perspective and steering away from a product-centric view, we illustrate that these propositions can be misleading.

4c) In contrast to the suggestions brought forward by 'front end' scholars, our data suggested that for really new product innovation with a low level of exploration senior management might better use directing instead of framing (table 9.1, configuration I).

Additionally,

4d) We did not find that senior management changed its role when projects moved out of the development phase and entered the commercialization phase in spite of the changes in the level of exploration between the two phases. Again it is speculated that the commercialization phases

were too short and too tightly coupled with the development phases to observe changes in the role played by senior management.

Also,

4e) In contrast with previous literature (O'Reilly and Tushman 2008; Smith and Tushman 2005; Tushman and O'Reilly 1996) we did not observe that senior management had a large role in integrating exploration and exploitation in situations where units for exploration showed higher differentiation from the mainstream organization (table 9.1 and 9.2, configuration III and IIIa).

In the projects in this study, exploitation and exploration in market learning were mainly integrated by mechanisms such as meetings between project members acting on a relatively low hierarchical level. Because most of the literature on organizational ambidexterity ties exploitation to incremental innovation and exploration to really new innovation (Li et al. 2008b; Raisch and Birkinshaw 2008), we, again, speculate that this finding emerged due to our detailed perspective. It appears that with regard to successful product innovation, senior managers are more involved in integrating projects than in integrating knowledge resources which are the 'puzzle pieces' at a more detailed level. Also we did not find full time project leaders who acted in-between senior managers and project members and integrated exploration and exploitation as expected by Raisch and Birkinshaw (2008). A reason for this might be that only a minority of present-day innovation projects is led by full time project managers (Barczak et al. 2009).

Finally,

4f) We found that a low level of investment might have an impact on senior management involvement in market learning in the implementation phase of a project.

In project *Diffuse*, which is one of the two projects that fall into the medium level of exploration category and is the only project that showed a low level of investment, we found that senior management carried out a limited level of control in the implementation phase (table 9.2, configuration IIa). Most likely, the low level of investment did place this project at the bottom of senior management's priority list and they did not bother to carry out explicit control during project implementation.

Market knowledge generation

In the context of market knowledge generation in really new product innovation, specifically the marketing literature has recommended that organizations should mix primary and secondary data generation techniques to collect information on market segments and customers. In particular, it is recommended that development organizations should use experiential interaction with (potential) customers because it is this interaction that will yield marketing knowledge that is new to the firm. This interaction requires a non-competitive attitude towards knowledge sharing from the focal firm

and its (potential) customer. It should take the form of using experiential market research techniques, such as 'emphatic design' or testing product prototypes. These techniques can cross cognitive boundaries and allow for sharing knowledge of a tacit nature (Hamel and Prahalad 1994; Leonard 1995; Lynn et al. 1996; O'Connor 1998; Slater and Mohr 2006; von Hippel 1986).

From our data, it emerged that organizations generate market knowledge in every phase of the process. However, the practices that were used in the initiation phase were different from the ones that were used during project implementation.

5a) In the initiation phase, organizational members used market scanning to generate market knowledge (table 9.1, configuration I, II, and III).

Market scanning refers to the extent to which organizational members devote efforts to generating general market knowledge on events and trends, and 'foreseeing' developments in market segments. For scanning the market several channels were used. In all projects employees relied on secondary data by doing desk-research. In most projects, these secondary data were complemented by primary data that were gathered by visiting trade fairs, conferences and existing customers. When scanning, organizational members tried to cognitively and behaviorally decouple themselves from the firm's existing market knowledge on one, several, but not all, dimensions and open their eyes for opportunities for exploration. Employees had to 'unlearn' (Hedberg 1981) parts of their market knowledge to open themselves up for new market knowledge. For example, project members in project *Anti-resist* aimed at visiting existing customers in a familiar market segment to openly discuss emerging opportunities that potentially could lead to uncovering latent customer needs. In this case, our findings are largely in line with studies that uncovered that the ability to generate new external knowledge relies on a combination of external brokerage and internal absorptive capacity (Atuahene-Gima and Murray 2007; Holmqvist 2004; Liebeskind et al. 1996; Tiwana 2008).

5b) For the implementation phase, we found that organizational members narrowed down their focus and aimed at collaborating with one or several (potential) customers to explore and refine product prototypes (table 9.2, configuration Ia, IIa, and IIIa).

During the development part of the implementation phase, project prototypes were explored. Organizational members generated new market knowledge on one or two of three market knowledge dimensions: customer, product usage or application need, and updated market knowledge on one or two of the remaining dimensions. In the commercialization part of the implementation phase, prototypes were refined. Organizational members worked together with (potential) customers to update market knowledge until the product was ready for market introduction. Hence, it appeared that collaboration with customers to test prototypes in really new product development can be used for exploration as well as for exploitation purposes.

Furthermore, using the level of exploration as distinguishing contingency variable resulted in a difference in market knowledge generation practices between low- and medium-exploration projects

on one side, and high-exploration projects on the other side, that only received scarce attention in previous literature on market oriented product development.

5c) In two out of the five high-exploration projects, a formal process framework was used by project members to support market knowledge generation in the initiation phase (table 9.1, configuration III).

Although this task formalization was not present in the organizations in which the other three projects with the same market learning characteristics were situated, a respondent in project *Bond*, which is one of these other projects, explicitly articulated the need for such a framework as well. When linking this finding to theory, it can be argued that, generally, the literature has presented both positive and negative perspectives on the effects of task formalization (Adler and Borys 1996; Jaworski and Kohli 1993). The positive perspective argues that formalization provides guidance and clarifies responsibilities which can reduce role stress resulting in organizational members feeling and being more effective. The negative view, in contrast, argues that formalization reduces task variety and autonomy and therefore reduces intrinsic motivation, which creates resistance or decreases commitment to innovation and change. In our cases, the formal process framework had an enabling effect. It was seen as useful by organizational members in their efforts to generate and make sense of market data that was totally new to them as well as to the firm. Possible negative effects were mitigated by a certain level of self-control over the use or non-use of framework elements. Interestingly, we did not observe the use of, nor need for, a formal process framework in projects with a lower level of exploration (table 9.1, configuration I and II). This might be the result of differences in uncertainty and complexity between activities (Adler et al. 1999; Cardinal 2001; Levinthal and March 1993). The initiation of projects with a lower level of exploration was steered by a higher level of market knowledge that already resided in the firm. This reduced the potential variance of activities that could be pursued. For example, in project *Additive* (i.e. high level of exploration) organizational members widely searched for new opportunities, while functional specialists in project *Diffuse* (i.e. medium level of exploration) were more 'constrained' in their search for new opportunities. Project members in this latter project had to stay within a familiar market segment (i.e. light management). We observed that in these situations of lower levels of exploration, actionable results of knowledge searching were less uncertain and achieved faster than in situations of higher levels of exploration.

5d) It can be argued that because of less complexity and uncertainty in tasks, there was less need for a process framework to guide market knowledge generation in the initiation phase of low- and medium-exploration projects. It might be that a formal process framework for market knowledge generation in the initiation phase is only considered as 'useful' at an increased level of exploration.

Another practice that was used to generate market knowledge in product innovation and is not often discussed in existing literature on market oriented product development is hiring new employees.

5e) In three out of the five high-exploration projects, one or several segment specialists were hired to support market knowledge generation in project implementation (table 9.2 configuration IIIa).

These new employees had extensive expertise in the market segments that were uncovered by the firm when initiating these high-exploration projects. Several streams of literature have presented arguments in favor of hiring new employees for innovation purposes. In general, new employees may provide new cognitive resources and fresh social capital which enhance accessing, generating and interpreting new knowledge, thereby fostering organizational innovation (Ancona and Caldwell 1998; Cohen and Levinthal 1990; Perretti and Negro 2007; Ruekert 1992). However, there are also potential downsides to hiring new employees. Next to search costs, socialization processes between newcomers and current employees can be costly and difficult because they often do not share the same knowledge and predominant norms and values (Jackson et al. 1993).

5f) Because we did not find the practice of hiring segment specialists in any of the four cases with a low or medium level of exploration we might have captured a trade-off point by using the level of exploration as discriminating contingency. In situations of high levels of exploration, the benefits of hiring new employees might be more important than its detriments. In contrast, in situations with low and medium levels of exploration, the costs and difficulties of hiring new employees might be higher than its benefits.

Market knowledge integration

The two main tasks in product innovation are to physically make a new product and to sell it in the market (Cooper and Kleinschmidt 1986; Song and Montoya-Weiss 1998). To accomplish these tasks, firms need multiple knowledge resources and integrate these (Grant 1996b). Specifically, knowledge on the four identified market knowledge dimensions has to be integrated with knowledge on manufacturing and technologies (Danneels 2002). The marketing literature, work on product development, and research on knowledge integration have identified several practices to support the interaction between different functional specialists which, potentially, enhances knowledge integration (De Luca and Atuahene-Gima 2007; Grant 1996b; Griffin and Hauser 1996; Inkpen and Tsang 2005; Olson et al. 1995). These practices include, for instance, meetings between functional specialists and the use of specific liaison roles between departments. However, in using these practices, effective market knowledge integration may still be hampered by cognitive and relational barriers. While cognitive barriers can be overcome by practices such as using 'boundary objects' (Carlile 2002), overcoming relational barriers often needs more fundamental measures (Griffin and Hauser 1996; Inkpen and Tsang 2005; Kahn 1996). Firms can decrease relational barriers and

enhance collaboration by implementing interrelated reward criteria and incentive systems. These measures have the potential to reduce mistrust and increase collaboration between different functions.

6a) Based on our findings, we add to the abovementioned literature that the level of exploration and the product development process phase seem to matter in choosing suitable market knowledge integration practices.

We found differences between the practices in use in the initiation phases when contrasting them with the ones that were used for project implementation. Furthermore, specifically in the initiation phase we came across differences between low-exploration projects on one side and medium- and high-exploration projects on the other side.

6b) During the initiation of projects with a low level of exploration (table 9.1, configuration I), in which senior management had a relatively large role, market knowledge was integrated by using the hierarchy of authority.

Senior management directed functional specialists to update several market knowledge resources in their efforts to identify future product concepts and report back to them (i.e. directing). Subsequently, based on the feedback from these functional specialists these senior managers formulated broad application needs which could be used as guidelines for research departments. Using the terminology of studies on intra-organizational knowledge flows (Gupta and Govindarajan 2000; Schulz 2003): knowledge flows between different hierarchical levels (i.e. vertical knowledge flows) dominated knowledge flows between functional specialists acting on a similar hierarchical level (i.e. horizontal knowledge flows) in the initiation phase. This finding is in line with prior research which has argued that vertical knowledge flows, specifically top-down knowledge inflows, fit organizational activities with a low level of exploration and a high level of exploitation (Mom et al. 2007; Olson et al. 1995). These knowledge flows tend to posses a clear and proven understanding of cause-effect relationships and encourage the recipient organizational members to respond to problems and opportunities in familiar ways.

6c) In contrast, during the initiation of projects with a medium and high level of exploration, where senior management was less involved in the initiation phase, we observed horizontal instead of vertical knowledge flows (table 9.1, configuration II and III).

In the initiation phase of high-exploration projects, different functional specialists acting on a relatively low hierarchical level came together to discuss ideas and concepts which resulted in the integration of market knowledge with other relevant knowledge resources. Because these activities happened prior to an official project status and with limited senior management involvement, knowledge integration was dependent upon the internal organizational network ties among these

functional specialists[32]. In most of the projects, functional specialists had to search for complementary knowledge by using less familiar (i.e. weak) intra-organizational ties. For example, the sales manager in project *Foam* (organization Gamma) contacted her colleagues from on of Gamma's product lines and Gamma's marketing organization to discuss potential solutions to a customer problem. These were ad-hoc meetings outside the scope of her daily routines. According to social network theory, these less familiar intra-organizational ties can provide search benefits (Hansen 1999), autonomy (Perry-Smith and Shalley 2003), and diverse knowledge resources (Granovetter 1973) at low cost in terms of time and effort, making it possible to foster creative idea generation and concept development.

6d) We found that market knowledge integration during project implementation occurred by having recurrent team meetings, discussing prototypes, and using cross-functional implementation frameworks in all projects under study (configurations Ia, IIa and IIIa).

At the start of project implementation, the product concepts under study became officially legitimized by their home organization, were supported and controlled by senior management, and received an official project status. For low-exploration projects, this generally resulted in decision-making in market knowledge integration being delegated from a strategic level to a project level, decreasing the involvement of senior management. In contrast, for medium- and high-exploration projects, decision making in market knowledge integration shifted from a rather informal context with limited senior management involvement to a more formal context with increased senior management involvement. An important practice used for knowledge integration for project implementation that we found across projects was the use of recurrent meetings of small teams of functional specialists. Based on prior literature we can present arguments of why this practice fits so well with this specific product development phase. For instance the marketing and product development literatures show that project structure is an important antecedent of really new product innovation performance (Ancona and Caldwell 1992; Hansen 1999; Olson et al. 1995; Sheremata 2000; Tushman and Nadler 1978). In contrast to the initiation phase where knowledge integration often requires individuals with a wide network of weak ties, knowledge integration in the implementation phase benefits from small development groups with stronger ties, characterized by frequent two way interactions. These strong ties create trust and mutual understanding between functional specialists which are essential in carrying out highly interdependent and uncertain tasks such as the implementation of a really new product development project.

Recurrent meetings were complemented by discussing prototypes and, in some cases, using cross functional implementation frameworks. By using these boundary objects project members with different functional background were able to sufficiently cross cognitive barriers. With respect to using cross functional implementation frameworks, similar findings can be reported as the ones we presented on the formalization of market knowledge generation in an earlier section.

[32] The exception is project *Bond*. Because this project heavily relied on existing technology, it was possible for one application development manager to integrate all relevant knowledge in the initiation phase of the project.

Implementation frameworks had an enabling effect and were seen as useful by project members in their efforts to develop a common language and awareness of different responsibilities in product innovation across functional specialists. However, the non-use of an implementation framework in other cases showed that it is not always essential for market knowledge integration. Additionally, we did not find that the use or non-use of a cross-functional implementation framework was dependent on the level of required investments as in the case of senior management control.

Furthermore, in two projects (i.e. projects *Foam* and *Dye*) we observed that a certain lack of collaboration between several functional specialists hampered efficient market knowledge integration and, at least, slowed down project implementation. However, because these projects could still be introduced into the market this lack of collaboration did not have a strong impact on project effectiveness.

Finally, also with regard to market knowledge integration practices we did not find that the nature of practices in use changed when projects moved out of the development phase and entered the commercialization phase in spite of change in the level of exploration between the two product development phases.

9.4 Managerial implications

As was argued in the introduction of this book, limited attempts have been made to come up with principles and guidelines to help managers to resolve the market learning paradox that arises from renewing product offerings. Our research fills this gap and has clear implications for managers that have to deal with this challenge in their daily work. Based on our findings, we can provide guidance on what configuration of the marketing organization supports what market learning behavior. More specifically, our research can be used to assist managers in developing market knowledge resource typologies and to develop and use benchmarks in benchmarking studies. Additionally, considering supporting instruments of policy makers and governmental authorities, our research demonstrates the importance of hybrid education programs and facilitating networking between firms.

Developing market knowledge resource typologies

If managers want to address the market learning paradox, we suggest they move away from a product-centric view of the firm and develop a typology of market knowledge resources on which existing products are built. Because of the relatively tacit nature of market knowledge and its distribution across functional departments, such as sales, marketing, and application development, market knowledge resources are often not obvious and therefore hard to identify. A pragmatic approach to identify market knowledge resources is to explicitly classify the market segments that the firm already has constructed, customers that are targeted, how products are used in the market, and the customer applications in which products are used. In these efforts literature that is targeted to business practitioners can be helpful. Several of these studies have offered practical guidelines and case examples which can help managers in resource identification and classification, and developing consensus among different stakeholders (e.g. Marino 1996). Once a market knowledge

resource typology is developed, it can be used for mapping the existing product portfolio as well as current product development projects. In competition analysis, this typology may also be useful when estimating the nature of product portfolios of current and potential competitors.

A market knowledge resource typology can also be used as guideline for looking into the future. When developing product innovation strategies, or reviewing initiatives that emerge bottom up, senior managers can classify potential strategic options by assessing the degree of fit with existing market knowledge resources. The market knowledge resource typology can form the foundation for assessing what market knowledge resources are already in place and 'only' have to be updated and what knowledge resources have to be developed from scratch. In assessing strategic options, firms should take into account that leveraging existing market knowledge resources is an attractive option in product innovation. Cognitively this is easier and it involves lower risk than developing new products that are purely based on exploration in market learning.

Finally, a market knowledge resource typology can be used by managers in discussions on how to define and measure new product success or performance. It appears that the knowledge gained from failed projects is often instrumental in achieving subsequent successes (Maidique and Zirger 1985). However, traditional success measures of new products often view the project in isolation (e.g. sales figure, development timeframe, and market share). Their potential impact on later projects is not taken into account. A market resource typology can be helpful in developing complementary success measures that use a broader perspective and are not restricted to single projects (e.g. what was learned?). Adding these measures to the traditional measures provides a richer picture of new product success. For instance, a product that failed when judged on short-term financial measures may have contributed new knowledge about the attractiveness of a particular market segment. In turn, this knowledge may prevent future failures and increase the chances of future success. For high-exploration projects, these measures, which reflect long term investments and organizational learning, may even be more relevant than the traditional, single project, measures of success.

Developing and using benchmarks

Assessing strategic options requires honest judgment of existing marketing capabilities residing inside the firm. Managers need to understand the multiple and interrelated dimensions of the way marketing activities are arranged and have to be configured to reach objectives. Also they need to accept that there is no single configuration template that fits all product development situations. In this context, our work can be used for benchmarking purposes. Although benchmarking has been a popular management tool in areas such as operations and quality management, its use in marketing is less common. Benchmarking involves, at least, three key steps (Day 1994a):

1) Identifying a firm or group of firms with desired performance (i.e. benchmark firm);
2) Calibrating characteristics and practices that are believed to be important in creating the performance in the benchmark firm;
3) Identifying gaps between the benchmark firm and the firm undertaking the benchmarking.

Specifically, our research is helpful in steps one and two. We have presented firms that have successfully dealt with the market learning paradox and consequently have achieved desired performance (i.e. a product's market introduction). In addition, we have constructed the configuration profiles of ambidextrous marketing organizations that allowed these organizations to achieve this performance.

Identifying gaps between the benchmark firms and a firm undertaking the benchmarking can yield two general responses. First, managers of the firm undertaking the benchmarking may consider the existing configuration of their marketing organization as given. For this response our research provides insight into what type of market knowledge dynamics in product innovation will present the best fit with the existing configuration and therefore will, most likely, have the highest chance to be successfully carried out by the firm. For example, if organizational members that make up the firm's marketing function cannot be provided with slack resources and have little experience in working fairly outside the mainstream organization, we have shown that it makes little sense to pursue new product opportunities that target new market segments. In these situations, with the premise that solely relying on incremental innovations is not an option, it makes more sense to pursue really new product opportunities within existing market segments. Although pursuing these new product opportunities requires specific senior management roles, and market knowledge that is new to the firm, configurations that suit this situation do not call for adaptations in the organizational structure, hiring new employees, and installing additional processes to generate market knowledge. Second, in contrast to developing strategic options that fit existing organizational configurations, managers may decide to develop and execute gap-closing improvement strategies to move closer to the benchmark that allows them to move into strategic directions in which they never (successfully) went before. Also for these situations, our research offers guidelines. In particular we have presented targets for senior management involvement, the marketing function, and market generation and integration practices for different levels of exploration in market learning strategy and different product innovation process phases. These targets can be used by the organizations as benchmarks. This section continues with discussing these targets in more detail.

Based on our research we recommend that for projects with a low level of exploration the organizational members that carry out the project's marketing function should be employees with the primary task to link the organization to the market. They should have experience with marketing tasks and not have large responsibilities in other relevant product development areas such as research or manufacturing. In addition, it is not necessary to take these organizational members out of the mainstream organization and develop a separate exploratory marketing entity. Because of the low level of exploration in market learning, these managers are better off within the mainstream organization, from which they can more easily leverage existing marketing knowledge. If senior management allows it, it appears not problematic for these managers to carry out exploratory tasks in combination with assignments of a more routine nature. For senior management involvement in these projects we recommend that they should have a large stake in the initiation of the project's market learning efforts. They should be involved in market segment foresight studies to identify future developments and trends. They also should be involved as knowledge integrators, linking

market knowledge with other product innovation knowledge resources. However, senior managers should also delegate relatively specific market knowledge generation tasks to organizational members acting on a lower hierarchical level. In the implementation phase of low-exploration projects, senior management should be less directly involved in market learning efforts than in the initiation phase. For the implementation phase it is recommended that their involvement should consist of a mixture of control and support. Because innovation projects that require new market knowledge often take longer to develop and have less clearly defined and measurable markets than incremental innovations, control and support measures have to be adapted to the level of exploration in market learning. Projects with a certain level of exploration in market learning need support and control measures that have higher risk and failure tolerances than the ones used for incremental product innovation projects. If strict quantitative measures that are applied to incremental project are also applied to really new projects it is likely that most of the latter would never be implemented. For incremental projects, the market learning that takes place in the initiation phase is enough to make rather accurate projections about the market success of a new product. For these projects, senior management has to ask for unambiguous market data that are used in traditional financial measures such as Net Present Value. For really new projects, however, qualitative measures seem more appropriate. Points of attention might be answers to questions such as: 'Do we get positive feedback on product concepts at trade-fairs and conferences? What parties want to work with us to validate product concepts? Can we leverage our existing market knowledge to get involved in this market segment?' To generate market knowledge in low-exploration projects, organizational members that carry out the project's marketing function should have the skills to 'unlearn' some of their market knowledge, interview customers during the initiation of projects and work together with customers in the implementation period. Firms can nurture these skills by providing formal and informal training experiences, such as training on interviewing skills or market research techniques, reflection sessions, and coaching. The use of such programs represents a way to further increase employee sensitivity to market knowledge (Ruekert, 1992). Finally, market knowledge integration in the implementation phase of low-exploration projects benefits from structural interaction mechanisms such as recurrent meetings of a team with different functional specialists. However, it is likely that these interactions will only benefit knowledge integration when accompanied by a certain level of collaboration and limited cognitive barriers between functions. Collaboration can be increased by implementing clear and transparent organizational reward criteria and incentive systems for joint activities such as product development. These measures can reduce potential mistrust and strengthen collaboration among different functions (Griffin and Hauser 1996). Cognitive barriers, in turn, can be decreased by using prototypes in inter-functional discussions, and the realization and use of a cross-functional implementation framework. However, while discussing prototypes seems a practice that is generally applicable and beneficial, the benefits of the use of a cross-functional implementation framework seem more idiosyncratic and dependent on the heritage of the organization.

Our research suggests that configurations of the marketing organization that are used for low-exploration projects can, for the most part, also be used for projects with a medium level of

exploration in market learning. However, it is recommended that for these latter projects organizations should make two adaptations in the initiation phase. First, instead of directing, senior management should adopt a framing role. In this role, senior management articulates a strategic intent that should trigger corresponding market learning efforts by functional specialists without setting very specific directions. Examples are: 'We want to expand the application area of our current products' or 'Our organization aims at using technology X to develop new products for existing market segment Y'. Little direct involvement of senior management in actual market learning efforts requires that these managers can act as charismatic leaders that can inspire. Their framing should be expressed in language that is easily understood by organizational members that have to act on it. It has to be well communicated so that it can create 'rhetorical universes' which address gaps between the current and desired situation and stimulate action (Eccles and Nohria 1992). The second difference with low-exploration projects relates to senior management involvement in market knowledge integration during project initiation. While for low-exploration projects it is recommended that senior management is actively involved in market knowledge integration, for medium-exploration projects they should take a less active role. For medium-exploration projects it is recommended that market knowledge integration during initiation should consist of horizontal knowledge flows initiated by functional specialists using their internal organizational network. Although there are limitations resulting from lack of specialist knowledge and loss of efficiency, organizations can strengthen their employees' internal organizational network by adopting job-rotation and co-location schemes. Such mechanisms establish additional ties on top of the more formal functional department ties.

Suitable configurations of the marketing organization for projects with a high level of exploration in market learning, in turn, have some features in common with configurations that are appropriate for medium-exploration projects. However, in setting benchmarks, organizations should be aware that there are two main differences. The first difference relates to the marketing function. While for low- and medium-exploration projects we found that all organizational members that carried out this function generated and integrated market knowledge in combination with more routine tasks, this was not the case for high-exploration projects. In high-exploration projects, the marketing function was somewhat differentiated from the mainstream organization and the organizational members that carried out this function were partly or wholly released from routine tasks. Hence, for structuring the marketing function in high-exploration projects we recommend that organizations consider two options of differentiation. The first option is to apply task partitioning at the project level and make organizational members that act within the mainstream organization responsible for the project's exploitation part and other routine tasks and set other employees that focus on the project's exploration part aside from the mainstream organization. The second option is to apply more differentiation and separate the whole marketing function, give them responsibility for the project's exploration and exploitation in market learning and release them from routine tasks such as selling existing products. We think that organizational choices in this context may depend on aspects such as the possibilities for knowledge integration, the size of the organization, and the tightness of coupling between different market knowledge dimensions. The second difference in suitable

configurations for high-exploration projects when compared to projects that show a medium level of exploration is related to market knowledge generation. Although not all high-exploration projects showed similar characteristics, we uncovered two market knowledge generation practices in high-exploration projects that were not present in medium-exploration projects: using a framework in the initiation phase and hiring (a) segment specialist(s) in the implementation phase. Based on these findings we recommend that firms should consider implementing the abovementioned additional market knowledge generation practices when aiming to develop high-exploration projects.

Supporting instruments of policy makers and governmental authorities

Considering supporting instruments, our research also has implications for policy makers and governmental authorities. As governments are concerned with economic growth, innovation is a key theme for policy makers. An important challenge is the transformation of (generic) technologies into commercially viable products. As was shown by our research this process can be enhanced by a well developed market orientation of workers in firms in which product and process technology is of major importance. By stimulating technology focused higher education institutes, such as technical universities, to develop hybrid programs that focus on technical fields as well as on business fields, policy makers can already contribute to this at the start of many careers. For instance, a bachelor's or master's degree in chemistry combined with a master's degree in marketing can lay a solid foundation for becoming a technical marketing professional.

In addition we have illustrated that really new product development is often initiated by the market scanning efforts of firms, aiming at getting in contact with potential customers and organizations that act within market spaces that are new to the focal firm. In this context, we can recommend governmental authorities at different legislative levels to facilitate the networking between firms. Support programs, for instance, can be focused on networking events and developing awareness of the importance of collaborative innovation.

9.5 Limitations and suggestions for further research

As every research our investigation also suffers from some limitations that provide meaningful opportunities for further research. We believe that there are several directions in which our research can be extended by using a similar research design. In addition, we draw attention to two other research directions and identify some methodological aspects that need further consideration.

Extension of the research using a similar research design

In our view, important directions in which the current research can be extended are studying other industries, other organizational dimensions, and other knowledge resources.

This study has focused on identifying ambidextrous marketing organizations that allow *chemical* firms to resolve the market learning paradox in really new product development. Although we believe in the value of single industry studies, and we are confirmed in this view by a significant amount of prior research, the question remains if our conclusions hold up in other industries. Even though product innovation is of the utmost importance in the chemical sector, we do acknowledge,

however, that compared to contexts such as electronics the industry can be characterized as a medium-tech industry with medium levels of change in customer preferences (Mizik and Jacobson 2003). It may be that organizations operating in more turbulent environments need alternative configurations of their marketing organization to effectively resolve market learning paradoxes. For example, focusing on exploration by means of structural differentiation may simply not be necessary or even impossible. Organizations in highly dynamic environments with very short product life cycles may be engaged in persistent continuous change resulting in limited routine tasks and well-definable market segments. In these contexts, alternative organizational routines for resolving the market learning paradox may have a more prominent place. For instance, Brown and Eisenhardt (1997) studied product innovation in the turbulent computer industry of the 1990s, and found limited evidence of structural differentiation by which small exploratory units acted aside mainstream organizations. Instead, they found that successful organizations combined limited structure (e.g. priorities and responsibilities) with extensive interaction and freedom to improvise, used a wide variety of low cost probes, and implemented rhythmic transition processes to direct attention to different timeframes and the ties between them. Further research could add other industries to examine to what extent our findings can be transferred to other settings and look further into the generalizability of our results.

To arrive at comprehensive and general theory, we were forced to balance the complexity of a dynamic research design and data from ten cases with the simplicity of presenting evidence of only four broad dimensions of ambidextrous marketing organizations. We believe that a fruitful avenue for further research is to use a similar research design but include other, or a larger number of organizational elements. A potential 'candidate' could be organizational incentive and reward systems. From our data it emerged that functional specialists were, for a large part, stimulated to start generating and integrating market knowledge by directing and framing efforts of their senior management. Although these strategic processes are of great importance, we think that they need to be complemented by corresponding lower level indicators and incentive systems. Indeed, prior literature has suggested the impact of incentive systems on proper implementation of learning strategies (Dosi et al. 2003; Griffin and Hauser 1996; Jolink 2009; Leonard-Barton 1992). Maybe we implicitly captured some of the effect of these systems by focusing on the responsibilities of functional specialists. However, we did not explicitly address them in our research. For instance, the inferior collaboration between the marketing function and other functionalities in project *Dye* might be the result of lack in evaluations that use team performance indicators. Furthermore, additional research could include a more detailed perspective on the organizational hierarchy. For reasons of simplification, we made a distinction between two management layers in our research. We reserved the terms functional specialists and project members for organizational members that were involved in day-to-day product development activities and used the term senior management for the group of managers that acted on higher hierarchical levels. Further research could identify more hierarchical levels and unravel the potential differences between middle management and top management responsibilities, the nature of their involvement in single and multiple projects, and their interactions. When moving in this direction, prior work that includes three hierarchical levels in the

context of organizational renewal, such as Floyd and Lane's (2000) study, may be used as starting point.

Finally, our research design specifically put the spotlight on a firm's market knowledge resources. Another potential direction for further research might be to include other knowledge resources that are used in product development. For instance, one could study the impact of organizational configurations on technology learning and how it influences the interaction between different product innovation knowledge categories. To distinguish between exploitation and exploration in technology, one can make use of patent data as, for instance, was done by Rosenkopf and Nerkar (2001). Although several additional works also studied organizational learning in the context of technology (Ahuja and Lampert 2001; Danneels 2002; Katila and Ahuja 2002), different levels of exploration have, to the best of our knowledge, never been linked to suitable organizational configurations.

Other research directions

Besides the extension of our research with a similar research design we draw attention to two other, potentially interesting, research directions: the link between senior management involvement and level of investment, and the use of virtual customer environments.

In our data set, project *Diffuse* hardly needed demanding technological developments. In addition, the product could be manufactured in existing facilities and did not require extensive new market scanning. Putting it differently, although *Diffuse* was a discontinuous product development project because project members focused on a new application, it only needed a low level of investment. In comparison with other projects, *Diffuse* was the only project with these characteristics. Interestingly, it was also the only successful project for which senior management carried out limited control over market learning efforts. While we fully acknowledge that this relationship might be accidental, intuitively it makes sense. Senior management has many roles to play and therefore has to make priority lists to divide attention. It is likely that projects that involve more resources and represent large potential gains or losses are higher on these priority lists. However, while there is significant research on the role of senior management control in product innovation with different levels of innovativeness (Bonner et al. 2002; Cardinal 2001; Lewis et al. 2002; Sethi and Iqbal 2008; Swink 2000), there are less studies on this similar topic in the context of projects with different levels of investment. Beyond including the level of investment as control factor in quantitative theory testing studies, further research could treat it as a research topic in its own right. Does the notion of control differ in projects that require different levels of resources? Do firms that have control policies in place that take the level of investment into account perform better than firms that do not consider this aspect? These are questions in the management of innovation that require further attention.

Another theme is using virtual customer environments to generate market knowledge in product innovation. We found this particular practice in project *Gears*. In 2005, Alpha, *Gears'* home organization, partnered with a party that provided an online intermediary environment, linking chemicals and plastics producers with downstream designers. With this party they developed an online gear selector to get in contact and start co-development trajectories with potential customers.

This practice was not included in our final model because *Gears* was the only project in which it was observed. However, looking at other companies reveals that this practice is far from unique. In this day and age, firms across industries (e.g. Cisco, Bang & Olufsen, Levi's, Fiat, Microsoft, Lego) have started establishing virtual customer environments where customers can share knowledge and otherwise participate in product innovation (Nambisan 2002; Nambisan and Baron 2009; Prahalad and Ramaswamy 2000; von Hippel 2005). The adoption of these technologies has the potential to greatly enhance the connectivity between customers and producers and support new models of innovation with customer's partnering in the process as idea generators and implementers. As Sawney and Prandelli (2000: 31) have put it: new technologies enable 'a shift from a perspective of exploiting customer knowledge by the firm to a perspective of knowledge co-creation with the customers'. Although this trend has certainly gained a foothold in business practice and is likely to become more important in the future, research has only taken initial steps to gain understanding of these developments. Examples of potential questions to frame further research in this area are for instance: 'How do new ICT technologies change the nature of customer contributions to product innovation?' 'How should firms communicate their innovation objectives in virtual customer environments?' 'Do we need new marketing roles or positions to ensure the integration between a virtual customer environment and other organizational functions?'

Methodological aspects that need further consideration

Finally, we present several important directions for further research that are born out of the methodological limitations of our study: mitigating cognitive biases and impression management, including the 'other side of the story', and statistical generalization.

Studying dynamic organizational processes necessarily entails collecting longitudinal data. These data can be obtained by either observing the sequence of change events as they occur in real time or by retrospective reports (Poole et al. 2000: 118). Because of time restrictions we were forced to use the latter approach and collect most of our data after the project outcomes were known. Retrospective studies provide the advantage of knowing the 'big picture', how things developed, and what they brought as result. This post-hoc knowledge is valuable for data interpretation and constructing a narrative of the development process. However, there are also downsides. Prior knowledge of process outcomes, such as project success, invariably suffers from cognitive biases and impression management from both respondents and researchers (Huber and Power 1985). For instance, there is a tendency to filter out events that do not fit or that render the story less coherent. This tendency to reduce the 'difficult' nature of the data 'may result in censorship of interesting dynamics and minority views' (Poole et al., 2000: 118). Although we took several measures to minimize the negative aspects of retrospective studies (see chapter 4), additional studies which include real-time analyses may further reduce these. As proposed by Leonard-Barton (1990), these studies, for instance, could combine our retrospective results with real-time product innovation cases to better observe the change process throughout its unfolding.

In our study we took the firm as focal actor in market learning processes. For this reason we classified knowledge sharing between the firm and external parties, like customers, as market

knowledge generation, and knowledge sharing between groups and individuals within the firm as knowledge integration. Because we interviewed multiple individuals of different functional groups and hierarchical positions within the firm we obtained very detailed data on intra-firm relationships. This information allowed us to develop a detailed and balanced perspective on market knowledge integration in product innovation. In contrast, however, in our analyses of market knowledge generation we were rather one-sided. We solely analyzed this knowledge flow based on intra-organizational voices without including the 'other side of the story' that could be brought forward by customers. To extend our study, further research might use dyadic or network perspectives including more than one organization (Anderson et al. 1994). These research designs could facilitate painting a more complete picture of inter-organizational knowledge sharing and learning processes in product innovation.

Finally, although our cases were essential for building theory, they only permit a certain level of analytical generalization (Yin, 1994). Further research may also want to test the theoretical insights that were obtained by our study. Testing the relationships between ambidextrous marketing organizations, exploratory and exploitative market learning, and new product performance by large scale survey studies can result in statistical generalizations across various settings, thereby increasing external validity. In this respect, we think two viable approaches exist. The first one is to pick several elements from the organizational configuration and measure linear relationships. A second approach might be to test complete configurations by using profile deviation techniques (see e.g. Doty et al. 1993; Vorhies and Morgan 2003). By using these techniques researchers can quantitatively assess organizational configuration fit with a market learning strategy as the degree to which this configuration differs from an empirically derived ideal profile that achieves superior performance of strategy implementation. Furthermore, to include a dynamic perspective, and quantitatively investigate changes along the product development trajectory, methods such as panel data analysis (Lewis et al., 2002) or event history analysis (Lee and Pennings 2002; Poole et al. 2000) might be used. As final point, quantitative researchers should notice that our process perspective has resulted in several activity based concepts (e.g. hiring segment specialists). These concepts answer the call for conceptual development around key managerial activities to enable a more thorough treatment of the dynamics and events underlying product innovation (Dougherty 1996; Jelinek and Schoonhoven 1993). However, they are also far different from the well-developed traditional structural constructs such as formalization, centralization, and specialization that have dominated (marketing) configuration research (Burns and Stalker 1961; Olson et al. 2005; Ruekert et al. 1985; Vorhies and Morgan 2003). Consequently, quantitative researchers have to develop our concepts into measures and subject them to a rigorous purification process to ensure construct validity.

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Appendix A: Interview protocol organizational context

1) Organizational position interviewee

Could you please explain your position in the organization?

2) General overview organization

2.1 Could you briefly describe the markets of your organization?

- Products
- Added value of products (high/low)
- The number of competitors/intensity of competition
- What companies are direct/indirect customers (examples)
- The pace of change in technology
- Complexity of technology
- The pace of change in market demand

2.2 Could you briefly describe the organizational structure of your organization?

2.3 Could you briefly describe the general strategy of your organization?

3) Product development strategy

See the 'innovation map'

3.1 Could you please provide a rough estimation of the division of the product development budget for two categories of projects: incremental/really new? (in %)

3.2 Could you please provide a rough estimation of the division of projects in each category? (in %)

4) Product development process

4.1 Could you please indicate the general steps that are taken/or activities that are carried out when developing a new product?

4.2 Does the organization have a formal process for product development?

4.3 What do you consider to be the main differences between the processes for incremental and really new product development?

5) Product development of <u>really new</u> products

(In this research a distinction is made between three main-process steps: the initiation of new product ideas, the development of the new product, and the commercialization of the new product)

5.1 What organizational structure is used for the initiation of ideas, and what employees are involved? (For example: brainstorming in teams)

5.2 What organizational structure is used to develop a new product, and what employees are involved?

5.3 What organizational structure is used for product commercialization, and what employees are involved?

5.4 Are target markets identified in the initiation phase? In what way?

5.5 Does your organization stimulate the initiation of really new product development? In what way?

5.6 Is it possible that target markets change in the development and commercialization phases of a project? If so, who can initiate changes?

5.7 To what extent is the product development process formalized by specific rules and procedures?

5.8 Have criteria been specified to evaluate really new product ideas? What are these criteria? Is everyone familiar with them?

5.9 Is progress in the development and commercialization phases being measured? If so, what are criteria? Is everyone familiar with them?

5.10 Does your organization use particular targets with regard to really new product development?

5.11 Are these targets usually achieved/not achieved?

5.12 Does your organization, in general, introduce more/the same amount of/less really new products as compared to competitors?

6) Market information processing in really new product innovation

6.1 How is the marketing function organized within your organization?

6.2 What role does the marketing function, generally, play within really new product development?

6.3 What sources are used for generating market information on industrial customer needs and preferences? And on general trends in market segments?

6.4 Which techniques are used to generate information from these sources?

6.5 How does your organization distribute and use market information for the initiation of new product ideas?

6.6 Does your organization cooperate with (potential) industrial customers to develop a new product? And to commercialize a new product?

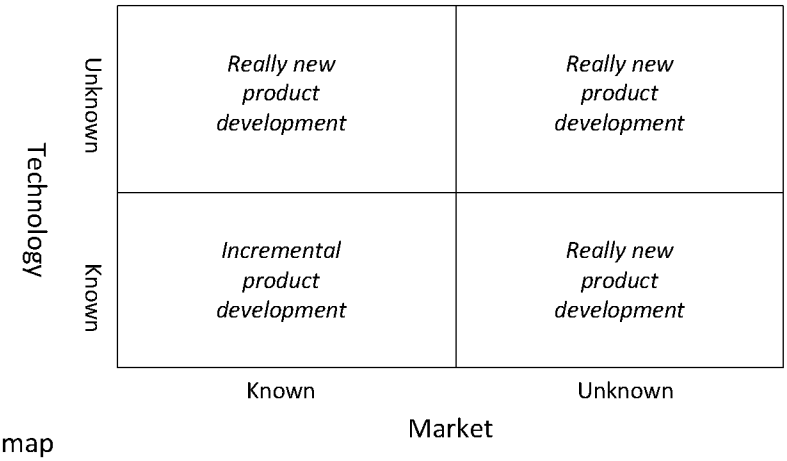
6.7 How does your organization distribute and use market information in the development and commercialization phases of product innovation?

7) Other organizational systems

7.1 Is training used to prepare employees for an orientation towards the market? Which employees are trained?

7.2 How do marketing and R&D work together in your organization?

7.3 How does your organization recruit employees that will be responsible for the marketing function in product innovation?



Innovation map

Appendix B: Interview protocol project

1) Respondent's role

1.1 Function within the company?

1.2 Role within the project?

2) General description project

2.1 Reason to start the project?

2.2 What is new in the project? ('innovation map')

3) General project characteristics

3.1 Could you please describe the project in terms of:
phases (and related time/budget/how far are you at the moment?);
who is/was involved? (directly and indirectly);
the management of the project (formal process? To what extent own decision-making?);
structure of the project/coordination (within the matrix, team?).

3.2 To what extent does the project represent the usual way a project is carried out? (why/why not?)

4) Initiation: Idea, and from idea to concept

4.1 Who proposed the original idea?

4.2 Was it an outsider/insider?

4.3 How did the idea relate to the existing product development strategy?

4.4 At that time, was there a pressure to come up with new ideas? (or did the existing business still delivered enough money?)

4.5 When did the idea/concept become an official product development project?

4.6 Who initiated the official product development project status?

4.7 According to your opinion, what were the personal motives of the initiator to start the project?

4.8 What were selection criteria to start the project?

4.9 Who provided/provides the resources for the project?

Product development is sometimes seen as entering into a series of 'challenges'

4.10 What 'challenges' were identified when turning the idea into a concept?

Examples possible challenges:
Acquiring knowledge on market domains;
Acquiring knowledge on customer needs;
The cooperation with customers of customers;
The cooperation between different functional specialists;
The development of the technology;
Receiving management support/funding.

4.11 How were these challenges dealt with (level of success)?

4.12 Did the people involved feel that they were well equipped to deal with the challenges?

4.13 Were there strict guidelines to deal with the challenges?

4.14 Was there a planning for this phase?

4.15 Was this phase monitored? How? By whom? What were criteria?

5) Implementation: Development and commercialization

5.1 What 'challenges' were identified when developing the product and introducing it into the market?

Examples possible challenges:
Acquiring knowledge on market domains;
Acquiring knowledge on customer needs;
The cooperation with customers of customers;

The cooperation between different functional specialists;
The development of the technology;
Receiving management support/funding.

5.2 How were these challenges dealt with (level of success)?

5.3 Did the people involved feel that they were well equipped to deal with the challenges?

5.4 Were there strict guidelines to deal with the challenges?

5.5 Was there a planning for this phase?

5.6 Was this phase monitored? How? By whom? What were criteria?

6a) Results <u>finished</u> project (project is introduced into the market)

6a.1 Do you think the project has been successful? Why? (effectiveness/efficiency)

6a.2 Is this opinion shared by organizational members that were not directly involved in the project? (e.g. senior management)

6a.3 If you could do the project again, is there something that you would do differently?

6a.4 What impact did the project have on the organization? (financially/non-financially)

6a.5 What impact did the project have on yourself? In what way?

6b) Results <u>running</u> project

6b.1 When will the project be successful? What dimensions are included? (effectiveness/efficiency)

6b.2 Does the team have confidence in the success of the project?

6b.3 Is this opinion shared by other organizational members that are not directly involved in the project? (e.g. senior management)

6b.4 If you could do the project again, is there something that you would do differently?

6b.5 Do you think the project will have an impact on the organization? In what way? (financially/non-financially)

6b.6 Do you think the project will have an impact on yourself? In what way?

Samenvatting (Dutch summary)

Ambidexter[33] marketingorganisaties om productontwikkeling te ondersteunen

Doel en relevantie van het onderzoek

Om als maakbedrijf te overleven in een wereld met toenemende globalisering, snelle technologische ontwikkelingen en complexe klanteneisen is innovatie in het productaanbod van groot belang. Wanneer bedrijven deze productinnovatie succesvol ten uitvoer willen brengen zijn marketingactiviteiten, zoals het uitvoeren van marktanalyses, het doen van marktonderzoek en het samenwerken met klanten essentieel. Deze processen zorgen niet alleen voor effectieve productinnovatie maar hebben ook een positief effect op haar efficiency. Echter er wordt ook gewaarschuwd voor de risico's van de bovenstaande activiteiten in de context van productinnovatie. Veel interactie met voor het bedrijf bekende markten en klanten kan een bedrijf erg gefocusseerd maken, waardoor het oogkleppen op krijgt en verzuimt zich mede te concentreren op ontwikkelingen die buiten de bekende aandachtgebieden vallen. Hierdoor kan het marktontwikkelingen missen die in de toekomst van het bedrijf van belang kunnen worden en kan de onderneming zelfs ten onder gaan.

Om echt marktgericht te innoveren zouden bedrijven het verfijnen van voor hen bekende kennis over de markt, een proces wat in dit onderzoek wordt aangeduid met de term *exploitatie*, moeten combineren met *exploratie* activiteiten waarin het bedrijf kennis over nieuwe klanten en marktsegmenten opdoet en gebruikt in productinnovatie. Binnen veel productinnovatieprojecten vervullen exploitatie en exploratie in het leren over de markt dan ook complementaire rollen. Exploitatie verhoogt de impact van exploratie doordat het nieuwe marktkennis verfijnt en concreter maakt gedurende het productontwikkelingsproces. Tegelijkertijd overwint exploratie de beperkingen van exploitatie zoals het onvermogen van het bedrijf zich aan te passen aan significante veranderingen in de omgeving.

Ondanks dat exploitatie en exploratie beide nodig zijn in productinnovatieprojecten blijkt het niet gemakkelijk beide marktleerprocessen binnen één project te combineren. Exploitatie en exploratie zijn fundamenteel verschillende strategieën die verschillende en tegenstrijdige mentale modellen en vaardigheden vereisen. Exploitatie bouwt voort op al bestaande kennis en betreft variatieverlagende activiteiten en het planmatig oplossen van problemen, terwijl exploratie geassocieerd kan worden met variatieverhogende activiteiten, leren door te doen, en toekomstgerichtheid. Omdat beide tegengestelde activiteiten schaarse middelen en aandacht nodig hebben creëert de combinatie van exploitatie en exploratie organisatorische uitdagingen. Organisaties worden geconfronteerd met een

[33] Van Dale Groot Woordenboek der Nederlandse Taal geeft aan het woord 'ambidexter' de volgende betekenissen: (1) lemand die zich even vaardig van de linker- als van de rechterhand weet te bedienen; (2) (figuurlijk) zeer handig man. In de bedrijfskunde wordt de term 'ambidexter organisatie' gebruikt om een 'duo-vaardige' of 'tweeledige' organisatie aan te duiden die in staat is exploitatie en exploratie te combineren.

'marktleer-paradox': de gelijktijdige aanwezigheid van tegengestelde markleer processen. Dit boek probeert *inzicht te geven in de manier waarop bedrijven deze uitdaging aangaan en hoe zij, organisatorisch gezien, de marktleer-paradox gedurende het verloop van echt vernieuwende productontwikkelingsprojecten proberen op te lossen.*

Voor theorievorming is dit onderzoek ondermeer van belang omdat de marketing discipline nog weinig aandacht heeft voor leerparadoxen. Hier is meer aandacht voor binnen het organisatie discipline. Vooral het onderzoek naar ambidexter organisaties gaat in op de vraag hoe organisaties leerparadoxen zouden kunnen oplossen. Echter dit laatstgenoemde onderzoek bevindt zich nog in de beginfase en daarom is er nog veel onduidelijk. In het bijzonder is onduidelijk hoe exploitatie en exploratie in individuele productontwikkelingsprojecten gecombineerd kunnen worden, hoe specifieke organisatieafdelingen of functies met deze combinatie omgaan, en hoe exploitatie en exploratie in de tijd gecombineerd worden. Dit onderzoek gaat dieper in op deze aspecten.

Dit onderzoek heeft ook waarde voor de praktijk. Ondanks dat het buiten kijf staat dat echt vernieuwende productontwikkeling steeds belangrijker wordt voor maakbedrijven zijn er nog steeds grote verschillen in productinnovatiesuccessen tussen bedrijven. Ook is er geconstateerd dat CEOs over het algemeen vinden dan de marketing functie een grotere bijdrage zou moeten leveren aan productinnovatie. Er zijn echter nog weinig richtlijnen en principes die managers helpen om met de marktleer-paradox in productinnovatie om te gaan. Tevens bestaat de gereedschapskist van adviseurs vooral uit oplossingen die hetzij het exploitatie aspect, hetzij het exploratie aspect ondersteunen. Er zijn nieuwe benaderingen nodig die juist de combinatie van exploitatie en exploratie als uitgangspunt nemen. Gedetailleerde en actiegeoriënteerde inzichten over hoe organisaties omgaan met de marktleer-paradox in productinnovatie zijn daarom belangrijk voor hedendaagse managers.

Theoretische achtergrond

Om een conceptueel raamwerk te ontwikkelen dat gebruikt kan worden als bril om naar de empirie te kijken zijn in dit onderzoek drie theoretische stromingen geïntegreerd. Om een overzicht te verkrijgen van de context waarin marktleerprocessen in productinnovatie voorkomen is gebruik gemaakt van inzichten uit de literatuur over productontwikkeling. Deze stroming is aangevuld met studies die zich richten de organisatie van kennis en leerprocessen binnen productinnovatie. Ten slotte is gebruik gemaakt van inzichten uit de marketingliteratuur om specifiek in te zoomen op de organisatie van de interactie van een bedrijf met de markt en haar klanten binnen productinnovatie.

Uit de studies over productontwikkeling kan worden afgeleid dat in het ontwikkelingsproces voor echt nieuwe producten drie verschillende fasen kunnen worden onderscheiden, te weten initiatie, ontwikkeling, en commercialisering, en dat 'leren door te doen' te prefereren is boven een scherpe scheiding tussen een uitgebreide planning en het uitvoeren van deze planning. Naast de activiteiten van projectleden speelt ook de betrokkenheid van het hogere management een rol bij het succesvol

ontwikkelen van echt nieuwe producten. Op basis van de bestudeerde literatuur zou het hogere management het traject moeten ondersteunen met middelen maar tegelijkertijd ook de voortgang van het traject moeten controleren.

Uit studies over kennis en leerprocessen in de context van productinnovatie kan worden afgeleid dat 'de generatie van kennis uit de externe omgeving' en de 'interne integratie van deze kennis' twee belangrijke kennisstromen in productontwikkeling zijn. Tevens kunnen specifieke organisatorische condities worden afgeleid die de bovengenoemde kennisstromen kunnen faciliteren. Deze tweede literatuurstroming heeft ook verder inzicht gegeven in de leerprocessen exploitatie en exploratie en hun betekenis in product innovatie. Als laatste zijn uit deze literatuurstroming verschillende algemene oplossingen gedestilleerd om de combinatie van exploitatie en exploratie organisatorisch vorm te geven.

De marketing literatuur heeft het inzicht verschaft dat marktgerichtheid een belangrijke voorwaarde is voor succesvol innoveren. Dit geldt voor zowel kleine aanpassingen in product-markt-combinaties als voor echt vernieuwende productinnovaties. Tevens maakt deze literatuur het mogelijk om vier categorieën van antecedenten voor marktgerichte echt vernieuwende productinnovatie aan te duiden: marketing functie, factoren gerelateerd aan het gedrag van het hogere management, marktinformatie generatie methoden, en de integratie van inzichten van verschillende functionele specialisten binnen de organisatie.

Conceptueel raamwerk

Gebaseerd op de drie bovengenoemde literatuurstromingen is een conceptueel raamwerk ontwikkeld. Dit raamwerk rust op vier assumpties met betrekking tot het marktleerproces in echt vernieuwende productontwikkeling:

1. Echt vernieuwende productontwikkeling is een proces dat opgedeeld kan worden in drie fasen, te weten initiatie, ontwikkeling, en commercialisering, en een passende werkstrategie is leren door te doen.
2. De effectiviteit en efficiency van echt vernieuwende productontwikkeling kan vergroot worden wanneer medewerkers die betrokken zijn bij productontwikkeling actief zijn in het 'leren over de markt' wat verwijst naar de generatie en integratie van marktkennis.
3. Marktleren in echt vernieuwende productontwikkeling bestaat uit een combinatie van exploitatie en exploratie.
4. De combinatie van exploitatie en exploratie in productinnovatie kan in één bepaalde tijdsperiode (binnen één productontwikkelingsfase) of in de tijd (verschillende productontwikkelingsfasen) plaatsvinden.

Tevens is aangenomen dat organisaties de marktleer-paradox in productinnovatie op zouden kunnen lossen door ambidexter marketingorganisaties te ontwikkelen. Dit zijn complexe organisatievormen

die een combinatie van exploitatie en exploratie in marktleren faciliteren. In een eerste poging de kernelementen uit deze organisatorische configuraties te duiden is uitgegaan van vier organisatorische elementen die gebaseerd zijn op het combineren van de drie bovengenoemde literatuurstromingen. Het eerste element is aangeduid met de naam 'marketing functie' en verwijst naar de organisatorische taken en verantwoordelijkheden van de projectleden die binnen een productontwikkelingsproject de schakel vormen tussen het project en de markt. Het tweede element is 'betrokkenheid van het hogere management' genoemd en verwijst naar de betrokkenheid van het hogere management bij het markleren binnen het productontwikkelingsproject. Het derde element is aangeduid met de term 'marktkennis generatie' en verwijst naar de praktijken die gebruikt worden om in productontwikkelingsprojecten marktkennis te genereren. Het element 'marktkennis integratie', tenslotte, verwijst naar praktijken die gebruikt worden om marktkennis binnen productontwikkelingsprojecten te integreren met andere vormen van kennis die van belang zijn bij productontwikkeling zoals technologische kennis. Verder is er van uitgegaan dat de bovengenoemde elementen op basis van empirisch onderzoek verfijnd zouden kunnen worden en dat specifieke configuraties van organisatorische elementen zouden kunnen veranderen gedurende het productontwikkelingsproces.

Methodologie

De empirische data die gebruikt zijn om het conceptueel raamwerk aan te scherpen zijn verkregen door gebruik te maken van een meervoudige casestudie in de context van de chemische industrie. Het ging daarbij om echt vernieuwende productontwikkelingprojecten (analyse-eenheid). Deze projecten zijn echter niet bestudeerd in isolatie maar er is ook gekeken naar het raakvlak van deze projecten met de organisaties waarin ze uitgevoerd zijn. In totaal zijn tien productontwikkelingsprojecten bestudeerd, in zes verschillende business units van zes verschillende multinationals die actief zijn in de chemische industrie. Negen van de tien projecten kennen een zekere mate van succes omdat hun resultaat, het nieuwe product, geïntroduceerd is in de markt. Data zijn gegenereerd door gebruik te maken van een combinatie van diepte-interviews, 44 in totaal, met project- en organisatieleden en het bestuderen van archiefdata, zoals aankondigingen van productintroducties, jaarverslagen en presentaties. Als eerste stap in de data analyse zijn de projecten afzonderlijk bestudeerd, daarna zijn vergelijkingen gemaakt tussen verschillende projecten. De totale analyse heeft geleid tot een genuanceerd raamwerk dat inzicht geeft in de manier waarop business units in de chemische industrie de marktleer-paradox in echt vernieuwende productontwikkelingsprojecten oplossen.

Marktkennis binnen productontwikkeling

De bevindingen uit dit onderzoek bevestigen eerder onderzoek dat marktkennis in productinnovatie gezien moet worden als een construct met meerdere dimensies. Echter, waar onderzoek in het veld van marketing en productontwikkeling doorgaans uitgaat van twee marktkennis dimensies: (1) Marktsegmenten-kennis en (2) klantenbehoeften-kennis, suggereert de data in dit onderzoek een indeling met vier dimensies: (1) Segmenten-kennis, (2) productgebruik-kennis, (3)

applicatiebehoeften-kennis en (4) klanten-kennis. *Segmenten-kennis* refereert naar kennis over de grootte van een bepaalde markt, het groeitempo van deze markt, en kennis over verschillende belanghebbenden en hun beleid in een bepaald marktsegment zoals concurrenten en wetgevende instanties die klantengedrag kunnen beïnvloeden. *Productgebruik-kennis* verwijst naar kennis over de manier waarop producten door klanten[34] gebruikt worden en hoe deze producten zich gedragen in de productieprocessen van klanten. *Applicatiebehoeften-kennis* refereert naar kennis over klantenbehoeften waarin een product ten aanzien van een bepaalde applicatie zou moeten voorzien. *Klanten-kennis* refereert naar overige kennis over klanten die relevant is binnen productontwikkeling zoals contact informatie en kennis over beslissers en beïnvloeders in het aankoopproces aan de zijde van de klant.

Verder is gevonden dat de combinatie van exploitatie en exploratie in de context van productinnovatie op twee manieren plaatsvindt. De eerste manier is de combinatie van exploitatie en exploratie in één productontwikkelingsfase, door binnen sommige marktkennisdimensies te exploiteren en binnen anderen te exploreren. De tweede manier is het combineren van exploitatie en exploratie binnen één marktkennisdimensie in de tijd. In dit geval vindt exploratie plaats in een bepaalde productontwikkelingsfase en schakelt men over op exploitatie in een volgende productontwikkelingsfase.

Op basis van de totale mate van exploratie in een productontwikkelingsproject was het tevens mogelijk om drie typen projecten te onderscheiden: (1) Projecten met een lage mate van exploratie lieten exploratie zien op één marktkennisdimensie, (2) projecten met een gemiddelde mate van exploratie lieten exploratie zien op twee marktkennisdimensies, (3) projecten met een hoge mate van exploratie, tenslotte, lieten exploratie zien op drie marktkennisdimensies. Ondanks dat de poging is ondernomen om zoveel mogelijk verschillen te creëren tussen onderzochte projecten laat deze studie zien dat de meest vruchtbare benadering aangaande productinnovatie ligt in exploitatie gecombineerd met een bepaalde mate van exploratie. In geen enkel project kwam het voor dat nieuwe kennis werd gegenereerd en geïntegreerd binnen alle vier de marktkennisdimensies.

Organisatorische configuraties

Aangaande ambidexter marketingorganisaties bleek dat organisaties in de chemische industrie niet gebruik maken van één bepaalde configuratie van hun marketingorganisatie om ambidexter te worden en de marktleer-paradox op te lossen. Door onderscheid te maken tussen projecten met een lage, gemiddelde en hoge mate van exploratie is gevonden dat de totale mate van exploratie invloed had op de passende configuratie van de marketingorganisatie. Tevens is gevonden dat de bovengenoemde configuraties veranderden in de tijd. De grootste verandering in de tijd vond plaats wanneer projecten uit de initiatiefase kwamen, waar marktleren gebruikt werd om ideeën te

[34] Wanneer in dit onderzoek gesproken wordt over klanten wordt er niet gesproken over de eindconsument maar over de volgende, business-to-business, klant in de keten.

ontwikkelen, en de implementatiefase ingingen, waar marktleren gebruikt werd om ideeën om te zetten in producten en deze producten te commercialiseren.

Voor projecten met een lage mate van exploratie is gevonden dat de marketingfunctie in de initiatie- en implementatiefase ingevuld werd door specialisten die als primaire taak hadden om de verbinding te vormen tussen de organisatie en de markt. Ook is gevonden dat de werknemers die in deze projecten de marketingfunctie uitvoerden een lage taakfocus hadden. Dit hield in dat deze werknemers naast de werkzaamheden in het productontwikkelingsproject ook verantwoordelijk waren voor taken in de dagelijkse bedrijfsvoering zoals het beantwoorden van vragen van klanten of het verkopen van bestaande producten. Met betrekking tot de betrokkenheid van het hogere management bij projecten met een lage mate van exploratie is gevonden dat deze leiders relatief sterk persoonlijk betrokken waren bij het marktleren in de initiatiefase. Zij leverden vooral een bijdrage door de projecten te initiëren en actief te zijn in de integratie van marktkennis met andere belangrijke kennisdomeinen in productontwikkeling zoals technologische kennis. De betrokkenheid van het hogere management in de implementatiefase van het productontwikkelingsproces veranderde van actieve betrokkenheid naar het delegeren van marktleer-activiteiten naar projectleden, het ondersteunen van deze activiteiten door het toekennen van middelen, en het controleren van deze activiteiten door het verlangen van voortgangsrapportages. In productontwikkelingsprojecten met een lage mate van exploratie werd marktkennis gegenereerd doordat projectleden elementen van hun bestaande marktkennis 'afleerden', klanten interviewden in de initiatiefase, en met klanten samenwerkten in implementatiefase. Ten slotte werd in projecten met een lage mate van exploratie de integratie van marktkennis, die in de initiatiefase voornamelijk uitgevoerd werd door het hogere management, in de implementatiefase uitgevoerd door projectleden. Hiervoor werden structurele integratiemechanismen gebruikt zoals periodieke teambijeenkomsten. Deze mechanismen werkten echter alleen goed wanneer er ook een zekere mate van samenwerking aanwezig was en er methoden werden gebruikt om cognitieve barrières te overwinnen zoals het gebruik van prototypen binnen inter-functionele discussies en, in sommige projecten, het inzetten van inter-functionele implementatieraamwerken zoals Stage-Gate processen.

Projecten met een gemiddelde mate van exploratie vertoonden op een aantal configuratie elementen overeenkomsten met lage-exploratie projecten. Echter, voor de initiatiefase werden er ook enkele belangrijke verschillen gevonden. In plaats van een actieve rol van het hogere management aangaande de initiatie van projecten, zoals werd aangetroffen in lage-exploratie projecten, werd in gemiddelde-exploratie projecten gevonden dat het hogere management de projecten niet initieerde maar een kaderscheppende rol innam. Dit hield in dat deze leiders een strategische richting formuleerden die functioneel specialisten op een lager hiërarchisch niveau een kader gaf om marktleer-activiteiten te ontplooien en projecten te initiëren. Een tweede geobserveerd verschil was dat het hogere management in gemiddelde-exploratie projecten, in tegenstelling tot lage-exploratie projecten, minder actief betrokken was bij de integratie van markennis. Deze integratie vond in deze projecten plaats doordat hiërarchisch lager geplaatste

functionele specialisten gebruik maakten van hun interne organisatorische netwerk om andere functionele specialisten op hetzelfde hiërarchische niveau te bereiken.

Projecten met een hoge mate van exploratie vertoonden, op hun beurt, vooral overeenkomsten met projecten met een gemiddelde mate van exploratie. Echter ook hier waren enkele belangrijke verschillende te duiden. Het eerste verschil betreft de marketingfunctie. Terwijl in gemiddelde-exploratie projecten gevonden werd dat organisatieleden die de marketingfunctie uitvoerden naast de werkzaamheden in het productontwikkelingsproject ook verantwoordelijk waren voor andere taken in de dagelijkse bedrijfsvoering was dit aanzienlijk minder het geval in hoge-exploratie projecten. In deze laatste projecten was de marketingfunctie minder geïntegreerd in de organisatie door gedeeltelijke of volledige vrijstelling van verantwoordelijkheid voor de dagelijkse bedrijfsvoering. Een tweede verschil met gemiddelde-exploratie projecten betrof marktkennis generatie activiteiten. In hoge-exploratie projecten werden twee additionele marktkennisgeneratie activiteiten geobserveerd die niet gevonden werden in gemiddelde-exploratie projecten: Het gebruik van een expliciet raamwerk met verschillende processtappen bij de generatie van marktkennis in de initiatiefase en het aannemen van specialisten aangaande het marktsegment dat de organisatie met het productontwikkelingsproject wilde betreden in de implementatiefase.

Implicaties voor managers

De bevindingen uit dit onderzoek zijn van belang voor managers die te maken hebben met de marktleer-paradox in hun dagelijkse werk. Gebaseerd op de resultaten van dit onderzoek kan gesteld worden dat managers die de marktleer-paradox in productinnovatie willen oplossen zouden moeten afstappen van een productcentrische kijk op de onderneming en de onderliggende marktkennis in kaart zouden moeten brengen. Deze analyse kan gebruikt worden bij het ontwikkelen en evalueren van productontwikkelingsstrategieën en in discussies over het bepalen van productontwikkelingsucces. Verder kunnen de configuratieprofielen van de ambidexter marketingorganisaties die geduid zijn in dit onderzoek gebruikt worden in zogenaamde 'benchmark' studies. De resultaten van dit onderzoek geven bedrijven inzicht in welke productontwikkelingsprojecten de grootste kans van slagen zouden hebben gezien hun huidige marketingorganisatie. Omgekeerd zouden op basis van deze onderzoeksresultaten organisaties ook kunnen kiezen om hun marketingorganisatie aan te passen in de richting van de 'benchmark' die beter past bij het uitvoeren van strategische keuzes.

Suggesties voor verder onderzoek

Tenslotte zijn enkele suggesties voor verder onderzoek geïdentificeerd. Om te bepalen of de bevindingen uit dit onderzoek stand houden in een bredere context zou dit onderzoek uitgebreid kunnen worden door dezelfde onderzoeksopzet toe te passen op andere industrieën en naast marktkennis te focusseren op andere kennis die van belang is bij productinnovatie. Ook lijkt, op basis van deze resultaten, nader onderzoek relevant naar de specifieke rollen van het top- en midden management in succesvolle productinnovatie en onderzoek naar de rol van virtuele

klantenomgevingen binnen productinnovatie. Methodologische aspecten die verdere aandacht verdienen zijn het verminderen van cognitieve vooringenomenheden en de constructie van gekleurde impressies binnen de dataverzameling, het includeren van het perspectief van de klant, en het testen van de ontwikkelde theorie op grotere schaal.

Summary

Ambidextrous marketing organizations to support product innovation

Aim and relevance of the research

For a manufacturing firm to survive in a world of increasing globalization, rapid technological development, and complex customer demands, product innovation is of major importance. When firms want to be successful product innovators, marketing activities, such as carrying out market analyses, doing market research and collaborating with customers, are essential. These activities do not only increase the effectiveness of product innovation, they also have a positive impact on its efficiency. However, there are also voices that warn for the risks of carrying out these marketing activities in the context of product innovation. Strong interaction with markets and customers that are well known to the firm can make the firm overly focused. An organization can become trapped by 'the tyranny of the served market' (Hamel and Prahalad 1994: 83) in which managers see the world only through their current customers' eyes. This may result in a situation in which they miss out on market developments that might become important for the company's future and it may even lead to the downfall of the organization.

To carry out really new market oriented product innovation, firms should combine refining market knowledge that is already known, called *exploitation*, with developing market knowledge that is new to the firm and use that in product innovation, called *exploration*. Within many of the product innovation projects mentioned above, exploitation and exploration in market learning fulfill complementary roles. Exploitation increases the impact of exploration by refining newly generated knowledge and reaping its benefits. Similarly, exploration overcomes the inherent limitations of exploitation, such as lack of breakthrough learning and the inability of adapting to significant environmental changes.

Although firms have to combine exploitation and exploration to be successful in really new product innovation projects, this is a difficult task. Exploitation and exploration are fundamentally different strategies and are associated with different and inconsistent mental models, skills and processes. Whereas exploitation is rooted in variance-decreasing activities, disciplined problem solving and the organization's past, exploration is about variance increasing activities, learning by doing and looking into the future. As both activities need scarce resources and attention the combination of exploitation and exploration creates organizational challenges. As such, organizations are confronted with a market learning paradox: the simultaneous presence of contradictory elements. This book aims to provide *insight into the way firms meet this challenge and how they try to resolve the market learning paradox from an organization point of view*.

The theoretical relevance of this research lies in the fact that, until now, research in marketing has had little attention for learning paradoxes. More than researchers in the field of marketing, scholars

of organization have paid attention to paradoxical thinking and organizing for exploitation and exploration in innovation. Specifically the research on organizational ambidexterity has focused on how organizations could resolve learning paradoxes. Yet, this research is still in an early stage of development. Until now, research on organizational ambidexterity has had little attention for combining exploitation an exploration in single product development projects, within specific departments and functions, and how exploitation and exploration are combined over time. This research addresses these aspects.

Next to making several theoretical contributions, this research is also relevant for managers and policy makers. Although it is beyond questioning that really new product development is increasingly important for manufacturing firms, few guidelines and principles have been developed that can help managers in dealing with learning paradoxes in product innovation. The majority of tools and advice have addressed either the exploitation part or the exploration part without looking at the other. New approaches are needed that specifically focus on the combination of the twin concepts. With large differences in product innovation success rates between firms, and CEOs demanding that the marketing function should play a more active role in product innovation there is still sufficient room for improvement. Detailed, action-oriented evidence concerning the way(s) firms are resolving the market learning paradox in product innovation is therefore highly relevant for contemporary managers.

Theoretical background

To develop a conceptual framework which can be used in empirical analyses, this research has integrated three steams of literature. To develop a context in which market learning processes in product innovation are present insights from the literature on product development have been used. This stream of literature has been complemented by a group of studies that offered detailed insights on the organization of knowledge and learning processes within product innovation. Finally, this research has made use of insights from the marketing literature to focus specifically on the organization of the interaction of the firm with the market and her customers in the context of product innovation.

Studies on new product development have made clear that really new product development can be seen as a process consisting of three phases: initiation, development, and commercialization, and that 'learning by doing' should be preferred over making the explicit separation between planning and execution. Besides these activities of project members, also the involvement of senior management is of importance for successful really new product development. The literature on product development has recommended that senior management supports these processes by providing resources but, at the same time, controls their progress.

Based on studies on knowledge and organizational learning processes in the context of product development the 'generation of knowledge from the external environment' and the 'internal

integration of this knowledge' were identified as two important knowledge flows in product innovation. Additionally, several organizational conditions were identified that could facilitate these knowledge flows. This second stream of literature has also brought further insight into the learning processes exploitation and exploration. Finally this stream of literature has offered several general solutions to organize the combination of exploitation and exploration.

The literature on marketing has brought the understanding that a market orientation is an important prerequisite for successful product innovation. This is the case for both small adaptations in product-market combinations and really new product development. Additionally, based on this stream of literature it was possible to identify four categories of antecedents of market oriented really new product development: marketing function, factors related to the behavior of senior management, market information generation methods, and cross-functional integration.

Conceptual framework

Based on the three steams of literature that were mentioned above a conceptual framework was developed. Within the conceptual framework the following four assumptions on market learning in really new product development were made:

- Really new product development is a process that can be subdivided into three phases: initiation, development, and commercialization, and a suitable working strategy is 'learning by doing'.
- The effectiveness and efficiency of really new product development projects is enhanced when project members engage in market learning, which refers to the generation and integration of market knowledge.
- Market learning in really new product development consists of a combination of exploitation and exploration.
- Combining exploitation and exploration in product innovation can take place in a single period in time (i.e. single product development phase) and over time (i.e. multiple product development phases).

Additionally, the assumption was made that organizations can resolve the market learning paradox in the course of really new product development projects by putting ambidextrous marketing organizations in place. These are complex organizational forms that facilitate a combination of exploitation and exploration. In a first attempt to identify the core organizational design dimensions for ambidextrous marketing organizations, this research relied on four broad organizational dimensions that could be derived from the three previously discussed streams of literature. The first dimension was named 'marketing function' and refers to the total number of tasks and responsibilities of the project members within product development project that form the linking pin between the project and the market. The second dimension was named 'the involvement of senior

management' and refers to the involvement of senior management in market learning in the context of a really new product development project. The third dimension was called 'market knowledge generation' and refers to the practices used to generate market knowledge in the context of a really new product development project. Finally, the dimension 'market knowledge integration' was denominated which refers to practices used to integrate market knowledge with other relevant knowledge resources in product development such as technological knowledge. Also it was assumed that the dimensions that were mentioned above could be refined by the empirical part of the research, and that configurations could change during the product development process.

Methodology

The empirical data that was used to refine the conceptual framework has been collected through a multiple case study in the chemical industry. The main unit of analysis has been the really new product development project. However, these projects were not studied in isolation. Also the interface of these projects with the organizations in which they were carried out was studied. In total, the empirical part of the research was based on a sample of ten projects in six business units of six different chemical firms. Nine of these ten projects could be considered successful because the result of the project, the new product, was introduced into the market. Data were generated by using a combination of in-depth interviews, 44 in total, with project and organization members, and studying archival data such as announcements of product introductions, annual reports, and presentations. The first step in data analysis concerned analyzing data from single cases. Additionally a cross-case comparison was made. The total analysis has resulted in a refined framework which provided insight into how business units in the chemical industry resolve the market learning paradox in really new product development projects.

Market knowledge within product development

The findings of this research have confirmed prior research arguing that market knowledge in product innovation should be considered a multi-dimensional construct. However, while most research in marketing and product innovation distinguishes between two dimensions of market knowledge in product innovation: (1) Market segment knowledge and (2) customer need knowledge, data from this study suggested four dimensions: (1) segment knowledge, (2) product usage knowledge, (3) application need knowledge, and (4) customer knowledge. *Segment knowledge* refers to knowledge on market size, growth rate, and turbulence, and stakeholders such as competitors and regulating groups that can influence customer behavior. *Product usage knowledge* is knowledge about the use of a product by customers[35] and the behavior of this product in downstream manufacturing processes. *Application need knowledge* is about knowledge on customer needs and wants a product should satisfy in a specific application and refers to specific application

[35] In this research the term 'customer' refers to business-to-business customers such as downstream manufacturers.

requirements. Finally, *customer knowledge* is about other relevant knowledge related to customers such as contact information, and knowledge on the 'decision making unit'.

Additionally, it was found that the combination of exploitation and exploration in the context of product innovation can happen in two ways. The first approach is to combine exploitation and exploration in a single product development phase by exploiting on several market knowledge dimensions and exploring on other market knowledge dimensions. The second approach is to combine exploitation and exploration within a single market knowledge dimension over time. In this case exploration happens in one product development phase and the switch to exploitation is made in the next product development phase.

Based on the overall level of exploration in a product development project it was also possible to distinguish between three types of projects: (1) Projects with a low level of exploration in market learning demonstrated exploration on one market knowledge dimension; (2) projects with a medium level of exploration demonstrated exploration on two market knowledge dimensions; (3) finally, projects with a high level of exploration demonstrated exploration on three market knowledge dimensions. Although attempts were made to select a wide variety of product innovation projects, from this study it appeared that the most fruitful approach to product innovation lies at the intersection of exploitation and some level of exploration. Hence, in none of the projects under study it was found that new knowledge was generated and integrated on all four market knowledge dimensions.

Organizational configurations

It was also found that organizations in the chemical industry do not use one typical configuration of their marketing organization to become ambidextrous and resolve the market learning paradox in product development. By distinguishing between projects with a low, medium, and high level of exploration it was found that the overall level of exploration in market learning had an influence on the suitable configuration of the marketing organization. Additionally, it was found that these configurations changed in the course of a product innovation project. In this respect, the most significant change was observed when projects moved out of the initiation phase, where market learning was used for idea generation, and entered the implementation phase, where market learning was used in developing ideas into products and commercializing these products.

For projects with a low level of exploration it was found that the marketing function in the initiation and implementation phases was carried out by specialists: Employees with the primary task to link the organization to the market. Additionally, it was found that employees that carried out the marketing function in these projects had a low task focus which means that besides the work they did for the product development project under study they were also responsible for tasks in the running business such as answering customer questions or selling existing products. Regarding senior management involvement in projects with a low level of exploration it was found that these seniors

had a relatively strong personal involvement in marketing learning in the initiation phase. The involvement of senior management in the implementation phase of the product development project changed from active involvement in the generation and integration of market knowledge to delegating these activities to functional specialists acting on a lower hierarchical level. The generation of market knowledge in product development projects with a low level of exploration was mainly carried out by project members that carried out the marketing function. These employees 'unlearned' some of their market knowledge, interviewed customers in the initiation phase, and worked together with customers in the implementation phase. Finally, market knowledge integration in projects with a low level of exploration, which was mainly carried out by senior management in the initiation phase, was carried out by functional specialists acting on a lower hierarchical level in the implementation phase. To support this integration, integration mechanisms such as recurrent team meetings were used. However, these mechanisms only worked well when they were combined with a certain level of collaboration and methods to decrease cognitive barriers such as using prototypes in inter-functional discussions, and, in some projects, applying inter-functional implementation frameworks such as Stage Gate processes.

Regarding organizational configurations, projects with a medium level of exploration showed similarities on some aspects when compared to projects with a low level of exploration. However, regarding the initiation phase some important differences were found. Instead of an active role of senior management with respect to the generation and integration of market knowledge, as was found in low-exploration projects, in medium-exploration projects senior management took a framing role. This means that these leaders formulated a relatively broad strategic direction which triggered corresponding market learning behavior by functional specialists acting on a lower hierarchical level without setting very specific directions. A second difference was that senior management in medium-exploration projects, in contrast with low-exploration projects, was less actively involved in market knowledge integration. In these projects, this integration was mainly done by functional specialists at a lower hierarchical level who made use of their inter-organizational network to reach other employees acting at the same hierarchical level.

Configurations for projects with a high level of exploration, in turn, had some features in common with configurations that fitted projects with a medium level of exploration. However, also in this case some important differences could be identified. The first difference related to the marketing function. While in medium-exploration projects organizational members that carried out the marketing function in the projects under study were also responsible for other tasks in the running business this was far less the case in high exploration projects. In these latter projects, the marketing function was less integrated in the mainstream organization because it was partly or completely released from tasks in the running business. The second difference with medium exploration projects related to market knowledge generation activities. In high-exploration projects two additional market knowledge generation activities were observed: The use of an explicit framework with different process steps that was focused on the generation of market knowledge in the initiation

phase, and hiring new employees that were specialists on the market the organization wanted to enter with the product innovation project.

Implications for managers

The findings of this research are important for managers that have to deal with the market learning paradox in their daily job. Based on the results of this research it can be argued that managers that want to resolve the market learning paradox should move away from a product-centric view on the organization and map the underlying market knowledge resources. This analysis can be used for the development and evaluation of product development strategies, and in discussions on the identification of product innovation success. Additionally, the configuration profiles of the ambidextrous marketing organization that were identified in this study can be used for so-called benchmark studies. By making use of the results of this study organization could gain insight into which product development projects potentially have the highest success-rate based on the existing marketing organization. Conversely, based on the results of this research, organizations could also choose to adapt their marketing organization in the direction of the benchmark that fits their strategic direction.

Suggestions for further research

Finally, some opportunities for further research were identified. To determine if findings from this research also have validity in a larger context, this research could be extended by using a similar research design and study other industries or include other knowledge resources that are important in product innovation. Other research directions that, based on this research, seem fruitful are research on the specific roles of top and middle management in successful product innovation, and research on virtual customer environments in the context of product innovation. Methodological aspects that deserve further attention are mitigating cognitive barriers and impression management in data collection, including the customer's perspective, and statistical generalization of the theory that was developed.

About the author

Armand Smits (1978) studied Marketing Management (Ba) at Avans University of Applied Sciences from 1996 until 2000. Subsequently, he studied Business Administration (MSc) at Radboud University Nijmegen. He wrote his master's thesis on market forecasting accuracy in product innovation at Philips Consumer Electronics and obtained his degree in 2003. After working and traveling in India he started as an analyst for market research agency GfK in 2004. Since 2006 he has been conducting his PhD research at Radboud University at the MICORD research group. While working on his dissertation he has presented his work at several national and international conferences and has participated in several (international) workshops. He has also been involved in teaching various courses at Radboud University, both at the Faculty of Science and the Nijmegen School of Management. He currently works as a post-doctoral researcher at Maastricht University where he is affiliated with the Maastricht Center for Entrepreneurship.